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THE AUTOMOBILE SHOW.

The general interest in automobilism and the magnitude of the new industry are well exemplified in the fine show now being given in this city at Madison Square Garden. In many respects the fourth show far surpasses its predecessors, and there are many indications which go to prove that the interest shown by the public is not fugitive and ephemeral, but deep-seated and permanent. The bicycle now seems to have been a craze, though we cannot personally understand why people have dropped it so generally as a means of exercise; but the automobile appears to meet many human wants and necessities, and we can see no reason why its ability to fill them should not make it a lasting and enormous industrial success. We find encouragement also in the large display of electric vehicles. Out of 250 in the show, nearly 50 are of the electric class, and barely a dozen are steam, while gasoline claims about 175, the others being also gasoline, but of the motor bicycle type. There is nothing in such figures to make electrical engineers despair of the future, especially as a large proportion of the electrics are not of the fancy type, but strictly industrial and utilitarian. A great deal has been said about the inadequacy of the storage battery for such work, but these statistics are more or less of a vindication for it.

GERMAN PROGRESS IN ELECTRIC LIGHTING.

We are wonted to think of our German friends as in the very front rank of technical progress and so, indeed, they are; but the brief abstract of the statistics of central station lighting which was given in the Digest last week is not a little surprising. One would suppose that in an enterprising country of vast technical achievements where both apparatus and labor are far cheaper than with us, the electric lighting industry would have already shown a very complete stage of growth; but a comparison with the admirable data of Census Bulletin 5, dealing with American central stations, shows that the art here has reached at least a far completer stage of exploitation than in Germany. To begin with, there are 3,620 American stations, against 971 German stations, giving nearly twice the number of plants in proportion to the population and nearly four times the absolute number to our credit. This of itself is significant, but it is still more important to note that in spite of the large number of small plants in this country, the output holds fully up to the standard set by numbers. We have over 18,000,000 incandescent lamps connected, as against the 5,000,000 in the German stations, and 385,000 arcs, against their 93,000. In electric power we more than make up any deficit that might show elsewhere, for the American stations have about 620,000 hp connected to central stations, aside from the many private power plants, while Germany shows about 219,000 hp. It is thus evident that the average size of the American stations is not much less, in spite of the difference in density of population. This is borne out by the total capacity of the central station generators in the two countries, the American total being about 1,225,000 kw, the German total 395,000. It is apparent, however, that the many small American plants somewhat more than offset the effect of the very large plants in important centers. Reduced to round figures, the American plants average about 338 kw, the German about 420. We should have anticipated a larger difference.

The upshot of the matter is that in proportion to the population electric lights are used almost twice as freely here as in Germany.

In particular we use arc lights conspicuously more extensively, in which work the small plants take a very important part. As regards the general character of the installations, there are some very notable differences in the practice of the two countries. The German stations, thanks to the general density of the population, adhere far more closely to direct-current machinery than we do here. Five-eighths of the total dynamo capacity in Germany is in direct-current generators, while here five-eighths is in alternating generators, polyphase and other. As a natural result of this preponderance of direct-current working, the German stations use storage batteries far more freely than they are used here, not only relatively, but absolutely. In fact, they employ battery capacity aggregating 87,000 kw, while here the meagre total is barely over 30,000 kw. Likewise, they use gas engines relatively more than we do, 61 stations aggregating 6,378 kw, reporting gas as a motive power, while the American total is 1,218 rated hp in the engines. Moreover, there is a preponderance of German effort in wind power, one station of 220-kw capacity reporting that unique condition. A full report on this curio would make interesting reading. In the use of water power we are at an obvious advantage in the matter of natural resources, and in fact 22.2 per cent. of our total capacity is in water wheels, the German figure being about 15 per cent. As regards the sale of the product, it is noticeable that the Germans use meters far more freely than is the custom here. To be specific, they employ 203,758, while those reported here amount to 582,689. This perhaps is the result again of the many small American stations doing a disproportionate amount of arc lighting, and letting things go on the contract basis. Certainly our large stations have long ago learned the necessity of metered service.

In spite of the relatively smaller use of electric lighting in Germany, the growth of the industry there has been striking. It must be remembered that Germany, with all its splendid standing in the world's work, is not a rich country as regards the mass of its people. It is burdened with militarism and has a vast amount of unproductive capital and worse than unproductive labor devoted to preparations for the discomfiture of possible obtrusive neighbors. Considering this, Germany's progress in the arts of peace is doubly creditable. The growth of central station lighting shows nothing of the tremendous impetus given to American lighting by the introduction of the alternating system; but oddly enough, 1898 was the banner year for construction in both countries. In that year 150 central stations were built in Germany and 277 in the United States. Since then there has been less activity, but the growth in output has certainly been very great. At present in both countries the profitable field is doubtless fairly well covered; but existing plants are growing rapidly. The many undeveloped American water powers give promise of great increase in central stations devoted mainly to power distribution, but neither here nor in Germany can there be expected a rapid increase in the number of lighting stations. As we glance over the German report the impression is brought to us that the German development has been along more conservative lines than our own. It has been there more confined to the larger cities and towns, has had to cover less unproductive territory and has steadily followed the line of least resistance. In some respects it has had to meet severer competition than that encountered here, for Germany is the home of the Welsbach burner, which has made here relatively little impression. A pfennig looks bigger in Germany than a cent does here, and the closer competition has tended to economical practice in station design and operation. But we doubt whether the big German stations show better results than the big stations here, although our small stations might suffer by a comparison.

Wireless.

About once in so often we feel it incumbent upon us to stir up our wireless friends with a sharp stick, and to inquire politely but firmly what they are doing about it. We are not aware that wireless telegraphers have acquired the habit of hibernation, but so little has been heard from them of late that we fear they may be emulating the woodchuck. If so, will they come out temporarily as per schedule on Candlemas day? Possibly the Donnybrook Fair inaugurated at the yacht races, where a dozen or so syntonic culturists indulged in a free extra terrestrial fight, may have left some of the participants in a state of coma; or the language which then belabored the ether—language we understand that would make Dr. Parkhurst turn pale and Anthony Comstock throw a fit—may have shocked some sensitive souls into silence. Be that as it may, it is certain that, for several months little has been heard from the wireless contingent, save the usual nautical dispatches sent when the apparatus happens to be working. We have described a new system or two and will joyfully describe their practical operations when we get a chance. But the great transmissions, conquering sea and land with their well-marshalled etherial battalions seem to be in the state cheerfully referred to by Artemus Ward as non-ester. Really, we should begin to get discouraged were it not for our faith in the useful future of the art and our keen remembrance of the dreary early history of the telephone. That great invention knocked about at least a half a dozen years before it really got anywhere, and wireless telegraphy, for its age, is relatively in better case than the telephone. On the other hand, a great electrical discovery should be far more quickly turned to account now than a quarter century ago. More than anything else, wireless telegraphy needs a careful non-partisan study of working conditions. We understand that the British Post Office is testing very thoroughly various systems and we hope in due time that the results in detail will be given to the public. This is good as far as it goes, but the relation of conditions external to the apparatus to results obtained is a matter of more vital interest, as disclosing the nature of possible limitations, if such exist.

A Method of Photographing Alternating Current Wave Forms.

The adoption of alternating-current machinery for power transmission, due to the convenience and reliability of the alternating-current transformer, has rendered the study of the wave forms of alternating current very necessary. There are particular cases in which a ripple on the back of an alternating-current wave may play a more important part than the fundamental wave to which it belongs. A great variety of devices have been suggested and employed for detecting, or recording, the wave form of alternating currents. Where the waves have ample power, as in power transmission circuits, there are several forms of instruments in practical laboratory use which accomplish this result. Where, however, the current waves have but little power, as in telegraph circuits of earth and wire, or still more, in wireless telegraph circuits of earth and earth, or earth and upper atmosphere, there is no known apparatus, either for indicating, or for recording the wave form. Moreover, in telephone and wireless telegraph circuits the frequency is very high, often far above the frequency of oscillation of material vibrating systems. The periodic time of an oscillograph mirror is often about 100 microseconds, and any wave or ripple to be recorded should, therefore, have a period of at least several hundred microseconds. But a microsecond is a long dreary waste of time to a wireless telegraph wave, and 250 complete waves of wireless alternating current can comfortably find room within a hundred microseconds, from a hundred-foot mast or sending antenna.

Leaving, however, to the tender mercies of future time the care of the short and delicate wave forms in electric communication, the interest of to-day lies in the methods of recording the forms of waves that each occupy many miles of free space for their development. The Blondel oscillograph is a typical apparatus. A tiny mirror is supported on a loop of wire, the loop being held in a very intense magnetic field, and being traversed by the current to be investigated. The natural period of vibration being so short, the loop and mirror deflect at every ripple in the wave, and throw a tiny ray of light upon the surface of a steadily rotating drum, carrying a strip of sensitive kodak film. In order to obtain sufficient photographic action from so small a ray, moving with great speed over the film, the most intense luminous ray of the arc lamp is employed. In the ordinary oscillographic trace, as photographically developed and printed, the scale of time is given by the fundamental wave, which intersects the zero or middle line at definite intervals, the frequency of which is supposed to be known with a suitable degree of accuracy.

In the article appearing on page 169 of this number, Mr. C. J. Spencer describes a particular modification of an oscillograph of his own construction, in which the feature of particular interest lies in the method of marking off the time. It consists in employing an alternating-current arc lamp as the source of light for the reflected protographing ray. This has the advantage that when the wave to be recorded has a relatively long and somewhat uncertain or variable period, as in the secondary member of an induction motor, the time can be reckoned from the dotted photographic line of an alternating-current arc lamp, knowing the frequency of that current; whereas, the full photographic line obtained from a direct-current arc would require separate and additional means of determining the time measure. This device of a dotted photographic line might be very serviceable in some researches on long and variable wave lengths. It seems to have a lessened or doubtful value for short waves of readily measurable and definite lengths. Every device of this character becomes of greater interest as our knowledge of wave forms increases and the pursuit of that knowledge is pushed further afield.

INDUCTION MOTOR DESIGN.

Mr. Hobart's paper on the armature diameter of induction motors is an effective disclosure of some painfully common faults in design. The history of induction motor design is a curious story of the effect of fads and prejudices in forcing design into devious and unpleasant paths. Mr. Hobart, who was in the art almost at the beginning, must have a keen appreciation of this and could doubtless tell many an interesting tale if he were so disposed. In the beginning the induction motor was looked upon with ill-concealed distrust, not to say contempt, by the average electrical man. It came to us here labeled "Made in Germany," backed by the fame of Brown and the sonorous name of Dobrowolsky, and in spite of the earlier work of Tesla in this country, it was looked upon as an ill-omened intruder. The first accusation brought against it was that it gave no starting torque to speak of and hence was inapplicable to all the ordinary cases where direct-current motors could give plenty of torque, although in fact they generally did not need it. Hence, almost the first effort of the designer was to produce an induction motor which would give a powerful starting effort. This was successfully accomplished, and the motors were then grudgingly admitted to be capable of starting, but were alleged to require for that purpose enormous currents, so great as to render the whole class quite impracticable. A little attention to the starting resistance question soon settled this, and with it the accusation of bad power factor. A simple and robust motor had been produced capable of giving a powerful torque at starting without excessive current and of giving both good efficiency and good power factor. In these respects some of the early motors were as good as any of the later types, but they had, as a rule, high rotative speed.

This speed factor, of course, was the point next attacked by the direct-current contingent, and there was at once in every competitive case a cry for motors of abnormally low speed. This had to be met by extreme multipolar motors and then the problem of induction motor design was opened up in its broadest aspects. But even more trouble was in store, for there began to be a cry for small variation of speed with change of load, and as this property unfortunately could be easily obtained the demand was met, to the designer's great annoyance. We say unfortunately, for the result was the common introduction of speed specifications of a kind utterly needless for most practical purposes, and not then or at any time since commercially filled by direct-current machines. And thus the problem of design came up to the point where Mr. Hobart's paper is particularly pertinent. The fault of abnormally large inductance due to needlessly long end connections was a natural result of attempting to produce low-speed motors of moderate size with low armature resistance. In spite of skillful shaping of the teeth and reduction of the air-gap to the lowest possible figures, a good power factor became difficult of attainment, and as Mr. Hobart shows, the end connectors were chargeable with no inconsiderable part of the difficulty, although the fact was unrecognized. The resulting faults were beautifully emphasized in some of the motors produced a few years ago, when, in the struggle for simplicity of manufacture, several sizes of motor were built up from the same size of armature and field punchings. The more powerful machines of such a series were admirable, but as the cores were made shorter and shorter upon the same diameter and pole pitch, the area of the polar air-gap was reduced and the relative length of the end connectors increased, to the utter demoralization of the power factor.

If an induction motor must have low rotative speed the most favorable condition for obtaining it is a reduction of the frequency. If this be impracticable, the number of poles must be increased and then the trouble begins. Other things being equal, a large polar pitch is an advantage and hence the tendency is in the direction of a rather flat motor of rather large diameter. But as Mr. Hobart shows, this modification of proportions soon reaches its limit, since increase in the relative length of the end connectors brings its penalty in increased inductance just as surely as does decreased polar pitch. Here, as elsewhere, the designer is perpetually between Scylla and Charybdis, and whichever he chooses he is likely soon to adjudge the other preferable. Probably the most valuable means of getting a little leeway in the design of induction motors is to let up on the extreme requirement for constancy of speed, i. e., slightly to increase the losses in the secondary winding, compensating for the loss elsewhere. It makes a vast difference in the ease of design and in the cost of getting other good qualities whether the slip at load is two per cent. or four per cent., while as a practical matter of every-day use, the latter specification is, in nineteen cases out of twenty, quite as appropriate as the former. Mr. Hobart has done the art of design a service in forcibly pointing out one of the limitations which is sure to be encountered in building motors of the freak class sometimes demanded. Induction motor design, like all design of electromagnetic mechanisms, is a matter of finesse, of adroit compromise between conflicting requirements, and he is most successful at it who knows best the lengths to which he can go in any direction without defeating his ends. Practical papers like the one under discussion are, therefore, very important in bringing to hand the data on which construction must be based, and in defining the bounds of improvement.

Radium at the Technology Club.

The Technology Club of New York, composed of graduates of the Massachusetts Institute of Technology, has held some very interesting meetings this winter, the last of which was devoted to the subject of radium, and was held at the consulting rooms of Dr. W. J. Morton, professor of electrotherapeutics in the New York Post-Graduate School and Hospital. The unusual facilities of the doctor's laboratory enabled some very striking demonstrations to be made.

Dr. George F. Kunz, of Tiffany's, who has devoted so much time lately to radium and radioactive materials and the problems of the subject, gave first an interesting address on the general theme of his researches, to which attention has been called from time to time in these pages. He exhibited a number of specimens of radium and demonstrated their activity, including the first sample of American radium, and some radium ore obtained from deposits discovered in Colorado. He also made an exhibition of a sample of actinium, this being the first time it is said that it had been shown in New York. One striking experiment was where Dr. Kunz enclosed a minute sample of radium in its glass and rubber tube within three heavy outer tubes of lead, copper and iron, and then succeeded in making a diamond fluoresce brightly in the dark. This experiment was also repeated with success after placing the diamond at the bottom of a goblet of water. Dr. Kunz also made a very pretty illustration of radioactive effect by causing the diamond to fluoresce in contact with the mass of pitchblende which he had on his table. He also had a fine specimen of willemite and samples of Kunzite to demonstrate their sensitiveness and responsiveness to radium.

Dr. Morton made a most brilliant and charming address on the general subject of radium in relation to medicine, and expressed great hopefulness with regard to the treatment of cancer and diseases of that type by radium and the X-ray. He spoke of results in several cases of disease not far advanced in which certain improvement, if not entire cure, had decidedly resulted; and he exhibited to the engineers present the apparatus employed in such work, explaining as well the various methods and principles upon which such cures could be attempted and effected. He created the utmost interest by referring especially to his own original work on the utilization of the artificial fluorescence of living tissue. It will probably be remembered by our readers that as far back as last June he contributed to our pages an article on this subject, in which he stated that he had then been treating cancer for over a year on this basis with results which could not be obtained by the X-ray alone. We may refer our readers to the article in the issue of June 20.

Dr. Morton exhibited five bottles of fluorescent liquids or solutions of quinine, æsculine, fluorescin, resorcin, etc., all of which he described as beautifully fluorescent under radioactivity. Hence, if taken internally and the patient be then exposed to radioactivity, the violet rays are, so to speak, liberated or produced within the body and all the internal tissues are, in effect, bathed in sunshine. In this way there is set up in the part affected that actinic stimulus which is so beneficial to the human tissues if applied in the proper way and quantity. Dr. Morton referred to other work of this character, especially that which has been done in connection with the Curie laboratory in Paris, and did not hesitate to express great hopes as to what might come of such work in the future. His remarks were full of suggestiveness, as, for example, in regard to the immemorial use of mineral springs, whose waters he thought from the fact that they gave helium emanations might be regarded as especially radioactive, and for that reason, more than any other, beneficial in their inward and outward effects. The bottles of fluorescing liquids were exposed by Drs. Morton and Reeves to the influence of the X-ray, so that the whole audience could see the row of them vividly fluorescing under the action of the ray in the darkness, confirming the statements that had been made as to this phenomenon.

The publication of Dr. Morton's statements in all the newspapers the following morning was followed by a perfect storm of publicity, criticism and discussion all over the country, from which it may be inferred that the authenticated facts given to the engineers, and the theories advanced may be productive of a great advance in the science of electrotherapeutics, particularly as related to radium and the X-ray. The remark of Dr. Morton that these liquids had been humorously dubbed "liquid sunshine" has been caught up, and the phrase has already gone into the popular slang of the day.

The Institute Annual Dinner.

Preparations for the annual dinner of the American Institute of Electrical Engineers on February 11, at the Waldorf-Astoria, are being pushed actively, and provision is being made for 500 guests on that very interesting occasion. The notices to members, with details, will be issued in a few days. In the meantime some particulars can be given as to the arrangements. Tickets for the dinner will be $7 per cover, without wine, and $5 for ladies. A great many ladies are expected, as members are making frequent requests for such tickets. The ball room at the Waldorf is to be occupied, and Mr. Arthur Williams, chairman of the committee on decorations, is making admirable plans in regard to enhancing the beauty of that stately chamber. Mr. Calvin W. Rice, chairman of the Institute reception and entertainment committee, has already completed his plans for the exercises, which may now be briefly outlined. President Arnold will make an address and then Mr. Samuel Insull, chairman of the Edison Medal Association, will present to the Institute, on its behalf, the Edison medal, of which the Institute has already accepted the trusteeship. The gift will be accepted on the part of the Institute by Dr. A. E. Kennelly, of Harvard University, past president. The medal having been founded for the competition of electrical engineering graduates in universities and colleges in the United States and Canada, it will also be accepted in that respect by Prof. C. F. Brackett, of Princeton University, who was the first to make scientific tests in this country of the incandescent lamp. Mr. J. B. McCall, of Philadelphia, president of the Association of Edison Illuminating Companies, will then respond for that body, and Mr. C. L. Edgar, of Boston, president of the National Electric Light Association, will speak on behalf of the interests represented by that influential organization. Mr. T. C. Martin has been appointed toastmaster. Music is to be liberally interspersed throughout the proceedings, and the speeches, while brief, will derive unusual interest and importance from the occasion, which is intended to celebrate the twenty-fifth anniversary of the successful development and introduction of the incandescent lamp. There is also being prepared a handsome and artistic menu, which will embody several features of interest, and which will deserve being preserved as a souvenir of the event. Mr. Edison is to be present as a guest, but it is to be doubted whether he will break his invariable rule of never making any speeches.

Annual Meeting of Contractors.

The annual convention of the Electrical Contractors' Association of New York State was held this week at the Building Trades' Club in New York City, and was largely attended by contractors from all parts of the State, while many others from all parts of the Union were present for kindred national purposes, including Mr. E. McCleary, of Detroit, president of the National Electrical Contractors' Association. As our readers are well aware, the proceedings of these bodies are not of a public character; but it may be noted that changes among the New York State officers were made as follows: President, Marshall Barnes, Troy; vice-president, J. R. Strong, New York City; secretary, F. Fish, Rochester.

On the evening of January 19 the association gave its annual dinner, Delmonico's being the place selected, and some 120 sat down to the tables in the red room, the table reserved for the "baldheads" being illuminated with a "Hylo" lighthouse flashing a red light, over which a Tammany tiger appropriately wagged his tail and licked his chops. The only speech of the evening was an admirable address before dinner by Mr. J. C. Hatzel, although Mr. C. L. Eidlitz was perforce compelled to deliver several brief speeches in declining to deliver any. Among the guests were representatives of the inspection and insurance interests of the city: Prof. G. F. Sever, of Columbia University, and consulting engineer of the Department of Gas, Water and Electricity; Mr. G. H. Guy, secretary of the New York Electrical Society, and the technical press in the persons of W. H. Morton, Charles W. Price and T. C. Martin. After dinner, instead of speeches and toasts, there was a splendid vaudeville show with Mr. Eidlitz as impresario. The songs and dialogues abounded in clever personal "roasts" and gags, which were hailed with thunders of applause and laughter by all, even the victims.

Plant of the Columbus Power Company, Columbus, Ga.

THE city of Columbus, Ga., is an example of a thriving municipality which owes its existence very largely to the natural advantage of proximity to a large water power. Though it is located in a fertile cotton region and at the head of navigation on the Chattahoochie River, so that it has, on that account, a leading cotton shipping business, it also stands opposite a remarkable series of shoals in the river carrying a large amount of water. The Chattahoochie River drains a watershed of something like 3,500 square miles, and while it has the disadvantage common to most of the rivers of this section that it must pass great, quick-rising floods, it possesses a low-water flow that has encouraged several comparatively large power developments. Its channel for a long distance approaching Columbus is lined with precipitous rock banks confining the water in a way that causes quick changes of level, but otherwise favors impounding the water for successive utilization or periodic storage.

For a distance of 34 miles above Columbus, that is, to West Point, Ga., the power possibilities of the river may be apprehended from the fact that in this stretch there is a fall of 362 ft., 120 ft. of this occurring in the last four miles above navigable water. This last fall is distributed in a number of shoals which have long been harnessed to a greater or less extent, notably by the Eagle & Phœnix Mills. The low-water flow is probably 1,000 cu. ft. per second, so that there are available in the immediate vicinity of the city for the 120-ft. fall, some 13,500 gross hp. The average power, however, for the four miles of river in question would seem to be about 75,000 gross hp, this calculation being based on observations made at West Point for the State Geologist under the direction of Mr. B. M. Hall, hydrographer, and during 1896, which was a dry year. These figures indicate that the average flow for that year was about 4,650 cu. ft. at West Point, or, allowing 18 per cent. increase for the tributary streams between the two places, about 5,500 cu. ft. at Columbus. The flood water is sometimes ninety times greater than the low water.

FIG. 1.—INTERIOR VIEW OF COLUMBUS POWER HOUSE.

The power plant which forms the subject of this description was built by the Columbus Power Company to furnish electric power for public sale and to drive a mill constructed on the Georgia bluff of the river. The plant, which has been in operation for about three years, is located at a shoal known as Lovers' Leap, just beyond the limits proper of Columbus, and it was planned to obtain a head of 40 ft., so that when there is a multiplicity of plants on the river above it or the number of storage dams are sufficient to regulate the discharge of the river, an average of 25,000 hp can be approached. The development is of the class in which the power house is located at one end of the dam, so that the forebay is impounded by the dam and power house structure and no penstocks are necessary. This, however, applies to the main power house or power house No. 1. The power utilization for driving the mill has been made without employing electricity, the power delivered by the wheels being transmitted to the mill by means of a rope drive. The power house for this purpose, No. 2, is located a short distance down stream from power house No. 1 and is supplied with pressure water by means of penstocks let through the bulkhead wall which extends from house No. 1 to the river bank. In both cases tail water is discharged into the excavated river bed beneath the houses and the tail water reaches the main current a short distance below, the tail race channel being separated from the main stream by a wing wall formed by the rock excavation from the tail race. Power house No. 1 is designed to develop 6,000 hp in six units and No. 2 about 3,000 hp, mainly in two units. Half of each installation is now in place.

The dam is an interesting structure of boulder concrete masonry with a cut stone spillway surface. It stands at an average of about 33.5 ft. above the stream bed, bringing its crest at elevation 138.5, and it has a length of 975 ft. 8 in., with a rollway 727 ft. 8 in. long.

Power house No. 1 is 137 ft. long and 52 ft. wide and stands at the ends of the dam at an angle of 103° with it. It rests on heavy stone masonry foundations, the up-stream portions of which form the heavy bulkhead, which is continued beyond the power house into the river bank. This bulkhead is pierced by the six openings for the six units which will form the ultimate installation of the plant, a smaller opening for the exciter units and a large opening for the penstocks leading to power house No. 2. The openings in the bulkhead for power house No. 1 are short flumes or chambers in which are set the turbines, and the back end of each of the wheel chambers is closed, as usual in plants of this type, with a heavy plate or cover of cast iron and steel, on the other side of which is the main generator room. The power house proper is thus really located immediately beyond the bulkhead containing the wheel chambers and spans the beginning of the tail race, into which the wheels discharge by draft tubes inclined through the masonry of the bulkhead from the wheel chambers. The interior view of the station thus shows a row of alternators, which are direct-connected to the wheels, and presents an unusually pleasing aspect owing to the uniformity of apparatus and the general interior finish. The walls above the windows, which are unusually large for a water power plant, are of brick and the upper parts are painted white; the lower parts and the inner side of the roof are painted drab and the steel members of the roof trusses are black. At the middle of the station there is an extension 43½ ft. wide, giving the room at the center a width of 45 ft. This was provided for the switchboard on the main floor, switching apparatus below and lightning arresters and other devices above, where the transmission lines leave the building. The roof is of the ridge form with a hip over the switchboard addition, and monitors are provided for both the main and hip roofs.

The racks are of the usual construction supported on a framework of I-beams, giving the racks an inclination of about 12° with the vertical. The wheel chambers have a depth equal to the width of the upper part of the bulkhead, 21 ft., and are built with concrete floors, stone walls and brick arches 2 ft. thick, the arched roof on a 6-ft. radius. The gates to the entrance of the wheel chambers are of planking and are lifted by hand by means of a rack and pinion. The gates have cast-iron guides, bolted through the masonry to the cast-iron head at the down-stream end of the wheel chambers.

Each of the main wheel chambers contains a pair of horizontal 39-in. Hercules turbines made by the Holyoke Machine Company. They discharge into the same draft tube. The center of the wheels is 15 ft. below normal head water level and 25 ft. above normal tail water level. Under the total head of 40 ft. each pair of wheels

develops 1,484 hp at 200 r.p.m. Each draft tube is 7½ ft. in diameter at the turbine casing and expands to 10 ft. at the discharge end. It is embedded in concrete in the bulkhead wall, but the exposed surfaces of the masonry are faced with brick work. The discharge chamber in each case is 16 ft. wide and has a brick arched roof carried by piers 4 ft. thick. The piers and the arches support the floor and machinery in the generating room. On the assumption of 80 per cent. efficiency in the turbines, it will be seen that 410 cu. ft. of water are passed per second, which gives a velocity of flow into each wheel chamber of 3¼ ft. per second and through each draft tube from 9¼ to 5.2 ft. per second. The bottom of the discharge chamber was excavated to give a depth of water under normal conditions in the tail race of 10 to 15 ft.

Each pair of wheels is direct-connected to a two-phase alternator built by the Stanley Electric Manufacturing Company. At present three of these are installed. Each machine has a rated capacity of 1,080 kw at 6,000 volts and driven at 200 r.p.m. gives current at 60 cycles. Each is joined to the shaft wheels by a flexible leather coupling of the star shape. Under present demands two of the machines suffice, leaving the third as a reserve. Ordinarily, one of the units is run under constant gate at the turbine, while the other is controlled by a governor made by the Schenck Governor Company, of Meriden, Conn., which takes up the variations of the load by means of gate movements on the second pair of turbines. To the governed alternator a Queen recording tachometer is attached, this as a safeguard in the matter of speed, as most of the motors driven by the station are of the synchronous type. Both of the generators are started a little before 6 A.M. and one is shut down at 5.30 P.M., and the other at 11 P.M. During the noon hour one-half to two-thirds of the load is dropped and a similar drop takes place at 5.30 P.M., when the mills close, in case a few of the mills are run over-

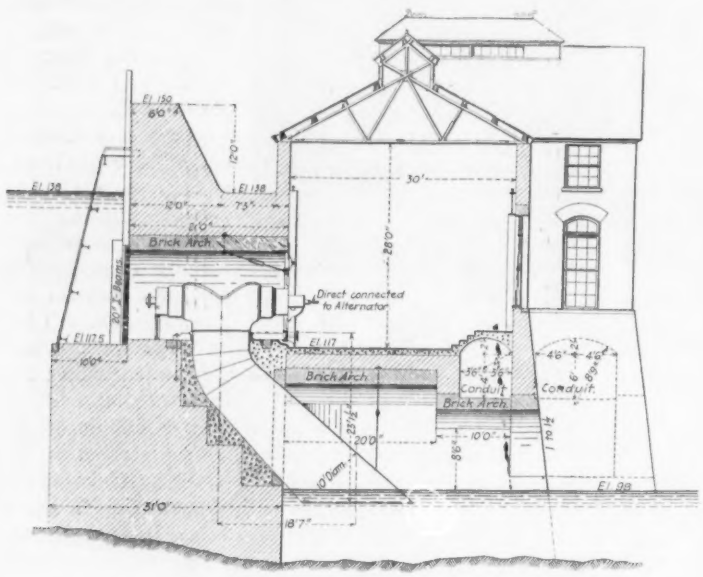


FIG. 2.—CROSS-SECTION OF COLUMBUS POWER STATION.

time; otherwise the load drops to one-sixth, being largely a demand for lighting.

There are two exciters directly connected to a single 18-in. Hercules wheel located in a chamber 4 ft. wide at the end of the station nearest the dam. Each exciter, which is of the Eddy type, has a capacity of 60 kw at 75 volts running at 450 r.p.m. They are at present operated at 60 volts and each generator takes at the present normal running from 70 to 80 amp. for the field current. During May the output of this plant was about 1,350 kw, so that power required for the field is less than 1 per cent. of the total. The modest requirement of energy for the field is in part due to the fact that the load is nearly all of synchronous motors, except for some lighting. The comparatively few induction motors in use are small and do not cause a noticeably lagging load. The exciters are operated under the control of mechanical governors.

The main generators have an efficiency of 96.4 and 96.5 per cent., and it is stated that the temperature rise in the armature coils has never been more than 15° above that of the room. This statement applies to a case where the load was seven-eighths of the rated and the room temperature 99°. The generator room is served by a 10-ton hand power traveling crane built by Chisholm & Moore, of Cleveland, and running the entire length of the room.

One of the interesting points in connection with the hydraulic equipment is the provision made for operating one of the flood gates in the dam by means of oil under pressure. Above the flood gates there is attached to the dam an hydraulic lift which consists of a

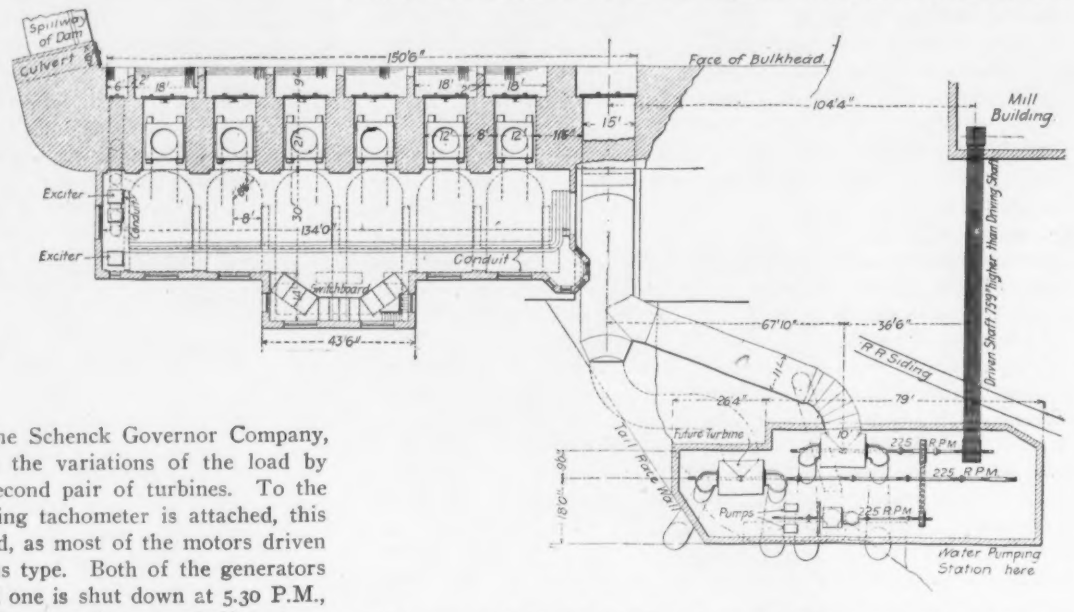


FIG. 3.—PLANS OF STATION OF COLUMBUS POWER COMPANY AND OF THE BIBB MANUFACTURING COMPANY PLANT.

large heavy cylinder and piston for lifting and lowering the flood gate by hydraulic pressure. Oil is used instead of water, so that difficulties due to freezing are obviated. The system is designed for 750 pounds' pressure and the piping is extra heavy with malleable footings. Pressure is maintained by a Stilwell-Bierce 1 x 6-in. triplex pump belt driven from one of the exciter units.

One of the features of the plant is the arrangement of the switchboard. When entirely completed this will consist of ten marble slabs erected to form three sides of a polygon, so that the switchboard attendant standing toward the center of the polygon can readily see all panels from the one position. Two sides of the polygon are at present installed and when the remaining three alternators are in place the third section will be erected. Another of the features of the plant is the provision of large cement-lined conduits under the floor of the station for the passage of conductors. These are virtually tunnels running lengthwise of the building, one under the generator room and the other under the switchboard ell, both painted white, lighted by incandescent lamps and nearly large enough for a man to walk through. As shown in the accompanying illustration, the wires and cables are neatly arranged on supports, which are creosoted wood easily distinguished against the white interior.

The section of the switchboard at the right consists of three generator panels. Each of these is divided into three parts, the uppermost carrying the indicating instruments, the middle the circuit-breakers, and the bottom instruments employed for the field current. The indicating instruments comprise two ammeters, one for each phase, and one voltmeter with the usual plug switch. There is also a pilot lamp and a synchronizing lamp. The circuit-breakers are of the oil-brake type used as switches and each is of the double-throw pattern, as there are two sets of bus-bars. On the bottom panels is a field ammeter and a rheostat wheel. An interesting point in this connection is the use of a small pulpit facing the switchboard, containing three rheostat wheels. Each of these is connected by shaft and gear under the floor with the gearing actuated by the rheostat wheel on the generator panel, so that the field current can be regulated either from the pulpit or from the switchboard. The connection of these two wheels is indicated when the operator moves the

wheel on the pulpit, as the wheel on the switchboard turns simultaneously with it.

The center section of the switchboard contains a panel for the exciters and space for three feeder panels, of which two are now in position. The exciter panel at the upper part contains a voltmeter and two ammeters, these for the two dynamos; at the middle two three-pole, single-throw switches, one for each machine, including the equalizer connection; and at the lowest the field rheostat controller. Each of the feeder panels is similar to the generator panel except that it also has two ground detectors and two recording wattmeters.

As already stated, the power from the plant is delivered largely to synchronous motors. Two of the largest motors driven by the plant are located about 1,500 ft. distant in a comparatively new mill erected by the Columbus Manufacturing Company. One of these is of 600-hp capacity at 225 r.p.m., and the other of 400 hp at the same speed. Each is started by an independent induction motor

FIG. 4.—POWER DAM ON THE CHATTAHOOCHIE RIVER.

spur-geared to it, these operated from the plant through transformers, which step down the pressure to 575 volts. The pressure at which the synchronous motors are designed to run after the synchronous speed is reached is 5,500 volts. Exciting current is obtained from a 9-kw, 125-volt dynamo, belt-driven from the main shaft. The synchronous motors are placed in line with each other, the switchboard faces them, the transformers are located in a separate room and the power plant generally for this mill presents a very fine appearance. The motors drive large sheaves carrying an European rope drive for the mill proper. The electric apparatus in this plant is of the General Electric manufacture and the switchboard is equipped with standard apparatus.

Power house No. 2 was erected to furnish power direct to the plant of the Bibb Manufacturing Company, whose mill is located on the bluff above Lovers' Leap, and to furnish light and water to this mill and the mill village. It contains space for two pairs of large water wheels and one smaller one, all of which are supplied with water from the forebay by a 15-ft. steel feeder pipe brought through the bulkhead alongside the inner end of power house No. 1. This feeder passes underneath the entrance to power house No. 1 and is divided into two branches, one 10 ft. in diameter and the other 11 ft. Each branch is planned to conduct the water to one of the large pair of wheels, and the larger penstock, in addition, serves the single wheel through a branch pipe 5 ft. in diameter. Power house No. 2 is located about 40 ft. below power house No. 1 and about 100 ft. below the forebay; the penstocks are, accordingly, short, and they are supported on brick piers 6 or 7 ft. apart and 3 ft. thick, with a rock fill between piers. The comparatively complex run of pressure piping and draft tubes resulting is indicated in the accompanying drawings. Each pair of the larger wheels, which are 36-in. horizontal Hercules wheels, is designed to drive a horizontal shaft at 225 r.p.m.; one of the units has been installed and is capable of developing 1,500 hp, which is transmitted to the Bibb mill by means of a rope driven on the American system installed by the Dodge Manufacturing Company. The single wheel is a 24-in. horizontal turbine and is used to drive the water-pumping machinery and the lighting generator.

The rope drive for this mill is an interesting one. The receiving shaft for the power transmission is 60 ft. higher than the driving shaft and approximately 116 ft. from center to center of the sheaves. Altogether there are about 7,000 ft. of rope carried in the drive, consisting of 30 wraps of 1½-in. manila rope. The driving sheave in the power house has a wooden enclosure fitted with window glass, while the transmission line between plant and mill is protected with a sheet-iron covering. This is stiffened by lateral angle irons, which also serve to discharge rain sidewise, so that it does not fall in a continuous stream toward the power house. The turbines are controlled by a Schenck governor to maintain a constant speed. The second unit to be installed is to have a capacity of 1,000 hp and the driving sheaves in the rope tower are mounted on quills with this idea in view, so that various drives can be shut down while allowing others to run, the drive in the mill building being of the usual class in which floors or departments are made independent. The quills are carried on an 8½-in. forged shaft which runs at 300 r.p.m. These various sections of rope transmission are provided with the usual electric tell-tales, so that any defects can be located and electric push buttons are conveniently located on each floor of the mill to signal the power house for stoppage of machinery at any time.

The single wheel in power house No. 2 has a capacity of 225 hp and drives a shaft from which the rest of the machinery is driven by belt. This includes a Stanley lighting unit of 150-kw capacity, giving three-phase alternating current at 250 volts and 75 cycles, running at 1,000 r.p.m., a Holyoke rotary duplex fire pump and a centrifugal pump and a triplex pump for the general water system. The Stanley machine is excited from a Northern Electric dynamo of 2-kw capacity and 120 volts belted to the generator.

FIG. 5.—POWER HOUSE, COLUMBUS, GA., BIBB MANUFACTURING COMPANY PLANT AT RIGHT.

The lighting system for Bibb City and mill is controlled from a switchboard in power house No. 2. There are eight feeders all told, five for mill lighting, one for arc lighting, one for the village houses and one for the office and boiler house. Each of the feeders is controlled by a three-pole, single-throw switch. The switchboard contains panels for the generator and standard instruments throughout. There were 101 houses in Bibb City in May for the mill operatives, each of which is supplied with water and with electric light free of charge. It will be interesting to add that the rent of the houses is based on the number of rooms and is 25 cents per room per week. Power house No. 2 has white brick walls with a slate-color wainscotting around the bottom and the under side of the roof is drab with a black striping on the roof members, which are of timber.

The water works comprise a large centrifugal pump for drawing water from the wheel case of the Bibb mill unit, a Deane triplex pump for lifting the water to the tank on the bluff and a New York filter of 500,000 gallons daily capacity. The centrifugal pump is

only used when the pressure of water in the wheel case is insufficient to pass the water through the filter, which carries 7 ft. of sand. Besides the filter there is the usual settling tank and clear water basin, and from this the Deane pump, which has 6 x 8-in. plungers, discharges to the storage tanks. One of these is of 100,000-gallons capacity for the general water supply of both the mill and the village, another is of 35,000-gallons capacity for fire purposes and a third is of 5,000-gallons capacity, situated in a tower of the mill and used for flushing purposes. The fire tank is, of course, connected independently to the fire pump. The large general storage tank is about 233 ft. above the pump and the smaller tank about 50 ft. lower than the large one. The discharge pipe from the pump has two branches, one to each tank. The flushing tank is provided with a large float gauge which is visible from the pump house and six or eight times a day the tank has to be filled. For general purposes between 60,000 and 70,000 gallons are pumped twice a day and the pump is operated on the branch that leads to this tank about two hours at a time. The centrifugal pump and both the filter and settling tanks can be by-passed at any time. The fire pump has two shafts which carry grooved wheels for friction driving.

The plant was designed by Mr. William C. Whitner, chief engineer of the water power development for the Virginia Passenger & Power Company, of Richmond, as chief engineer, and was constructed under the direction of Mr. William S. Lee, Jr., now chief engineer of the Catawba Power Company, near Rock Hill, S. C., as resident engineer. The officers of the company when the plant was erected were as follows: H. M. Comer, president; J. F. Hansom, G. Gunby Jordan, E. T. Comer and John Hill, directors. Mr. H. A. Tibbs is engineer of the electrical department.

The dam and power house were erected by Hardaway, Jones Company, of Columbus, contractors. The cost of the development completed will be about $450,000, or $50 per horse-power.

Radioactivity and Radiation.

BY DR. LOUIS BELL.

WITHIN the past year or two experiments on radium and other sources of radioactivity have been so multiplied and so diverse in methods and objects that it has been well nigh impossible to keep track of the work, much less to arrive at a clear appreciation of its significance. We have all got to speaking so glibly of electrons and ionization and such like things that we almost forget the distinction between hypothesis and fact, and take seriously a great deal of hasty deduction from imperfect data. Unhappily, the non-technical press has promulgated columns of misinformation under "scare" head lines. It is my purpose here not to discuss theories of radioactivity or to summarize the great mass of experiments upon the subject, but rather to call attention to some of the collateral researches which have thus far been lost in the shuffle or hastily assumed to confirm preconceived notions.

The point of view assumed in most recent work on radioactive substances has required that their properties should be explained in terms of electrically-charged atomic fragments. This line of work has certainly been fruitful, but in pursuing it very many experimenters have lost sight of everything else and particularly have forgotten the very existence of ordinary radiations of which visible light is the type. I long ago predicted that there would be a recrudescence of the emission theory of light as a result of this tendency to jump at conclusions, and such in fact there has been, but the wave theory is too firmly grounded to be shaken on any casual disturbances, and no one as yet has had the temerity to risk a serious assault.

Meanwhile some very important work has been done upon forms of ordinary radiation hitherto unknown or neglected, and the results are such as to demand attention. The work of Blondlot on the N-rays in particular is very far-reaching in its results, and throws much light on our hitherto very imperfect knowledge of the possibilities of wave radiation. Oddly enough, his work has attracted extraordinarily little attention outside of purely scientific circles.

The substance of it is that a large group of rays has been detected which has, as a whole, properties closely akin to those manifested by radioactive substances, but which is subject to the ordinary laws of radiant energy. The N-rays have a profound effect upon the conditions of electrical discharge, and were, in fact, detected by their accentuation of the electric spark; and yet they are reflected, refracted and polarized precisely like ordinary light. They produce a vigorous secondary activity in virtue of which bodies upon which they fall continue for a time to give out N-rays by a species of phosphorescence. One of the curious effects of this property is that the N-rays may seem to penetrate bodies in reality highly opaque to them, although their penetrative powers are actually rather conspicuous, yet selective in a way totally different from that found, for instance, for radium radiation. The N-rays seem to be received as part of the solar radiation, and hence are very widely found aside from their occurrence in the radiation from ordinary flames. Blondlot has not definitely determined their wave length, which probably varies over a considerable range, but it appears to be very great, forming a sort of connecting link between the low heat rays and the Hertzian waves of appreciable dimensions. They are very strongly refracted by quartz, which seems to present the phenomenon of anomalous dispersion for waves of this length.

Truth to tell, the spectrum from no source of radiation has as yet been completely investigated. It may be well known within a limited range, but that is all. Opacity is purely a relative term, and a given substance may stop completely ordinary forms of radiation and yet transmit energy of particular kinds with the utmost freedom. In view of such facts as these it is wise to go very slowly in the study of unusual manifestations of energy. Moreover, the theory of anomalous dispersion indicates that a substance may transmit certain wave lengths substantially unrefracted and inferentially unreflected, so that while the presence of reflection and refraction indicates that a given radiation is of the general nature of light, the absence of reflection and refraction does not necessarily remove it from this category.

A case somewhat analogous to the N-rays is found in a type of radiation recently studied by Sanford and reported in the *Physical Review*. The radiation in question proceeds from the cathode of an air condenser under high electric stress. It possesses strong photographic activity, and sets up strong secondary radiation of a similar but not identical kind. It has strong penetrative powers as regards some opaque bodies. When first announced it was regarded by some notable authorities as a clear case of cathode rays consisting of electrons, but on more complete investigation it turns out that it can be refracted, reflected and polarized, and is very probably ordinary radiation of short wave lengths, although the actual wave lengths have not yet been determined; and it is possible that anomalous dispersion may be concerned here, as with the N-rays whose index of refraction would have assigned them to the extreme violet at first sight.

The concurrent existence of material stream rays and ordinary rays like this and in the emanations of radium and the like make the resulting phenomena very difficult to diagnose. There is especial danger of confusing cause with effect and secondary effects with primary ones. For a complete solution of the problems presented, a far better knowledge of generalized ordinary radiation is necessary than is yet available, and in the case of radium et al. the chemistry of the substances needs persistent study to a degree which is very difficult considering the rarity of the materials. How much would we know of the wonderful and intricate phenomena resulting in the production of the photographic image if metallic silver had never been isolated and a rather impure silver bromide brought a hundred dollars a gram? It is a terrible handicap in the investigation to be cut off from ordinary chemical methods, and without their aid it would be little short of miraculous if serious blunders were avoided. As regards radium, the latest point is its breaking up, with the production of helium and another gas as yet unknown. As to the result there is no doubt, but it is quite another matter to explain where the helium comes from and whether it resulted from the decomposition of a chemical compound or the disintegration of an element into its primal constituents. A hundred grams of radium in skillful hands would answer many questions, but it is not forthcoming at present, and it is worthy of note that the Curies, who know the most about the chemistry of the wonderful stuff, scrupulously avoid sensational hypotheses and hold open minds for further developments. Their example is a good one for those less well informed to follow.

This is not written in the least as a counterblast against the very important and beautiful work that has been done in the study of radioactivity, but merely to call attention to the very imperfect knowledge of some of the possibly essential factors in the phenomena.

It is always unsafe in science to build too fast, lest the foundations prove faulty, and in the rapid progress made in the study of radio-activity a good many gaps have been left perilously near the bottom of things. In due time these may be filled up—or not, as the event may prove. But the material gathered is priceless and science can well afford for the sake of it to forgive any errors that may prove to have been committed in haste and enthusiasm. It is the final result that is important, not the peccadillos of the workmen.

A Method of Photographing Alternating-Current Wave Form.

BY C. J. SPENCER.

MOST central power stations are equipped with alternating-current machinery. Records are kept of ammeter, voltmeter and wattmeter readings, but very few have any records of curve shape. The shape of the curve often differs from the pure sine wave form. A peaked wave may have a maximum value considerably greater than that calculated from instrument readings, which are usually the square root of the mean square value. Thus two sources of e.m.f., giving the same value by voltmeter, may have such different

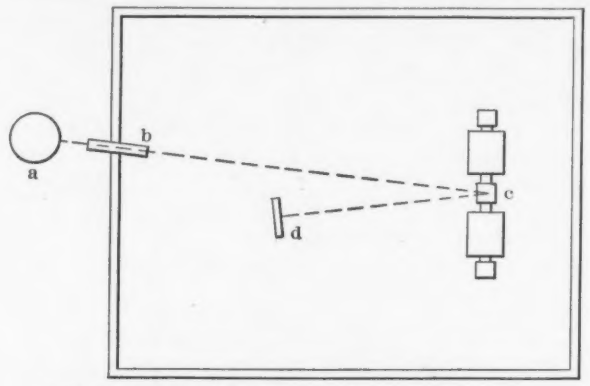


FIG. 1.—GENERAL ARRANGEMENT OF APPARATUS.

maximum values as to require different insulations. Transformer losses are less for a peaked wave than for a flat-topped wave. It is, therefore, important that the wave shape be measured.

The following method of photographing alternating-current wave form was devised by the writer while at Johns Hopkins University during the winter of 1897-98:

Fig. 1 shows the general arrangement of apparatus. An arc lamp is placed at *a*, a telescope at *b*, galvanometer at *c*, and photographic apparatus at *d*. The heavy lines show the boundaries of a dark room and the dotted lines show the path of light.

The arc lamp has no points of interest except that it must be

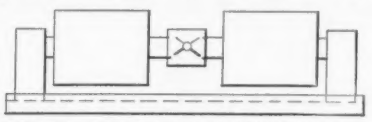


FIG. 2.—DIAGRAM OF GALVANOMETER.

alternating if a measure of time is desired. The telescope is intended to focus the light of the arc lamp on the galvanometer mirror. The galvanometer consists of an electromagnet and a moving coil with mirror, as shown in Fig. 2. It is essential that the moving parts be light and sensitive and that the suspension be stiff.

A kodak film on a roll, *a* (Fig. 3), with the end of the black paper attached to the film, fastened to roll *b*, which is turned by the spring, *c*, constitute the photographic apparatus. The path of light is at *X Y*.

The method of procedure is to connect the e.m.f. terminals to the galvanometer coil through a suitable non-inductive resistance. The arc lamp, galvanometer mirror and photographic apparatus are then adjusted until the light is seen to move along the path *X Y*. Roll *a* is then released and the film allowed to roll on *b*.

One-half of a period of an alternating current wave taken by this method, with the zero line drawn afterwards, is shown in Fig. 4. The light and dark spots are caused by the alternations of current in the arc lamp, and are an excellent measure of time. A 133-cycle

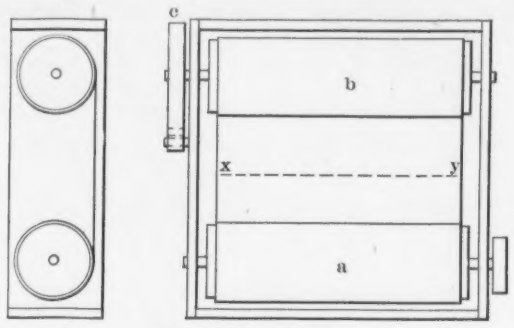


FIG. 3.—KODAK FILM.

current supplied the arc lamp, so the space between centers of dark spots represents 1/266 of a second. It might be supposed, on inspecting this curve, that the shape is due to the galvanometer period being too long. This is not the case, however, for the same curve taken by different methods had the same appearance for reasons given below.

The curve is that of the e.m.f. induced in the secondary of an induction motor. This was first investigated by Dr. Louis Duncan, who published the results of the test in the *Transactions* of the American Institute of Electrical Engineers in 1892, though he used a point and contact method for obtaining his results. The motor had collector rings attached to the secondary, for inserting resistance at starting, and was geared to an inverted rotary converter, supplying alternating current to the induction motor primary, with a gear reduction to give a known percentage slip. The converter thus drove the motor as a dynamo, with the secondary circuit practically open, one pair of slip rings being connected to the galvanometer through a high resistance. The reason for the curve being so irregular was on account of the construction of the motor, which had inwardly projecting pole pieces. The strength of the magnetic field decreased as it moved from a pole piece to the space between poles,

FIG. 4.—ALTERNATING-CURRENT WAVE.

and again increased at the next pole, thus giving a pulsating e.m.f. superimposed on the alternating e.m.f.

My apparatus for taking curves consisted in what I could find in our laboratory. The telescope was an iron gas pipe with a concave and a convex lens, of different focal lengths, stuck on opposite ends with sealing wax. A large electromagnet weighing about 100 pounds and intended for making experiments in magnetism, where great magnetic densities were required, served for the main part of the galvanometer. I made the coil with No. 36 B. & S. insulated wire, by winding the wire on a rod in a lathe, then pulling the coil thus formed out straight and wrapping a piece of No. 26 spring brass wire around each end. These pieces of wire when pulled taught made a very stiff suspension. Fig. 5 shows the coil in place. The suspension wires were fastened to fibre pieces, which were adjustable on a continuously-threaded brass rod, all being fastened in a brass box painted black. The mirror was very light and thin, about one-eighth inch in diameter, and fastened to the coil with wax. I did not photograph the reflection from the galvanometer at its own period, for it would have only shown a band of light. The period was very short.

I would suggest several improvements on the above apparatus. It should plot the zero line at the same time as the curve. This could be done by focusing a second spot of light to coincide with that reflected from the galvanometer mirror, when the coil is at rest. The line traced by this stationary source of light would serve as the zero line. It would be preferable to have the zero line traced by light from an alternating-current arc lamp, supplied by current of known frequency, and the curve plotted by reflected sunlight, or other light of great intensity. A second desirable addition would be to calibrate the curve with a direct current of known voltage. This could be done by impressing the known direct e.m.f. on the

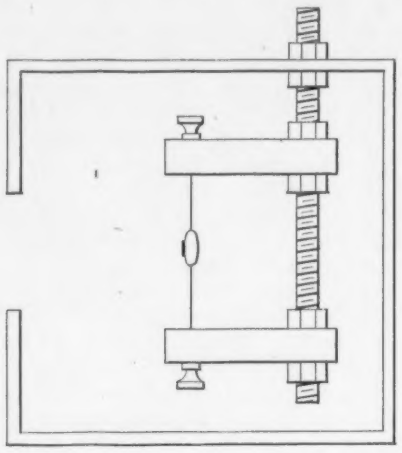


FIG. 5.—DIAGRAM SHOWING COIL IN PLACE.

galvanometer coil, while the film is moved a short distance, then reversing the e.m.f. on the galvanometer coil, while the film is again moved. Several values of e.m.f. can thus be photographed before taking the curve.

The above galvanometer is only suitable for tracing e.m.f. curves. In case it should be desired to trace a current curve, the field could be produced by a coil carrying the alternating current, provided the inductance due to producing the magnetic field is small compared to the rest of the circuit, and the moving coil is actuated by a direct current of constant value. A combination of alternating-current field and alternating e.m.f. impressed on the coil would give the power curve.

The Choice of Air Gap Diameter for Induction Motors.

By H. M. Hobart.

A COMMON error in induction-motor design consists in employing too great a rotor diameter with the intention of obtaining a high-power factor. The desired result is not necessarily thereby achieved, as the inductance of the end connections—a by no means inconsiderable percentage of the total inductance—increases with increased pitch.

It is the purpose of the present article, first by the method of treatment, to show the very great percentage which the inductance of the end connections may form of the total inductance;[1] and, secondly, to propose a practical and simple method by which the best proportions may be determined.

In Behrend's excellent treatise[2] on the induction motor, the following formula for the leakage factor is given:

$$\acute{o} = C \cdot \frac{\triangle}{\tau}$$

in which C is stated to be a constant depending upon the shape and size of the slot, and upon other conditions, $\triangle$ the radial depth of the air-gap, and τ the polar pitch. It is stated that C varies between 10 and 15 for half-open slots. Owing to its brevity this formula is exceedingly useful if judgment is used in the choice of the constant C.

In attempting to apply to the estimation of the inductance of the windings of an induction motor, principles analogous to those he has found very useful in estimating the inductance of the short circuited turns in commutating machines, the writer compiled Table

TABLE I.—LINES PER AMP.-TURN PER CENTIMETER OF "EMBEDDED" LENGTH.

Polar pitch in centimeters.	Wide-open slots.	Half-open slots.	Completely closed slots.
20	0.86	1.04	1.24
25	0.69	0.83	1.00
30	0.57	0.69	0.83
35	0.49	0.59	0.71
40	0.43	0.52	0.62
45	0.38	0.46	0.55

I, in which the lines per ampere-turn per centimeter of "embedded" length are taken as inversely proportional to the pitch, and has found it to give results in fair agreement with practice. Lines per ampere-turn per centimeter of "free" length may be taken at 0.4 for all values of the pitch. Of course, the mechanical arrangement (*i. e.*, grouping, etc.) of the end connections occasions considerable variations in this constant. Motors with squirrel-cage rotors take 0.3 lines per ampere-turn per centimeter of "free" length, taking as "free" length that of the stator winding.

The predetermination of the inductance of the windings of an induction motor, is analogous—so far as relates to the component quantities to be considered—to the predetermination of the magnetizing current which would be required for one phase of the stator winding, were the reluctance of the magnetic circuit that offered by all the paths exclusive of that path leading through the secondary winding.

This much more restricted available magnetic path largely accounts for the low values for the lines per ampere-turn per centimeter of "embedded" length, as set forth in Table I, as compared with the average values applicable to the short-circuited turns in commutating machines, namely, 4.0 c.g.s. lines per ampere-turn per centimeter of "embedded" length, and 0.8 c.g.s. lines per ampere-turn per centimeter of "free" length.

Furthermore, in induction motors we are concerned with the inductance, not of small compact groups of conductors occupying two or three centimeters of the periphery, but of the more or less spread-out groups corresponding to the conductors per pole per phase. In most induction motors, the polar pitch, τ, i. e., that portion of the periphery devoted to one pole (the gap periphery divided by the number of poles), amounts, according to the periodicity, the normal speed, the output and the designer's choice, to from 10 cms to 45 cm.; hence the belt of conductors belonging to one phase, occupies a peripheral width of from 6 cms to 15 cms.

The radial depth of winding is not generally different from that customary in continuous-current machines. The greater width contributes in a considerable degree to the small values to be employed for the lines per ampere-turn per centimetre of "embedded" length and "free" length, in deriving the inductance.

An example of the estimation of ó is—for illustrative purposes—worked out from the constants in Table I as a basis:

Diameter of air gap	102	centimeters
Periphery of air gap	322	centimeters
Number of poles	8	
Polar pitch	40.2	centimeters
Effective length of core parallel to shaft	25.4	centimeters
Mean length of one stator turn	181	centimeters
"Embedded" length per turn	51	centimeters
"Free" length per turn	130	centimeters
Lines per ampere-turn for "embedded" length	51x.44=22	
Lines per ampere-turn for "free" length	130x.40=52	
Total lines per ampere-turn	74	
Number of stator slots	120	
Number per pole per phase	5	
Conductors per slot	4	
Turns per pole per phase	10	
Lines per coil per ampere = 74 x 20	1480	
Inductance per coil = 20 x 1.480 x 10^{-8}	.000296	henry
Inductance per phase = .000296 x 4	.00118	henry
Periodicity	40	cycles per sec.
Reactance per phase = 6.28 x 40 x .00118	0.296	ohm.

The slots are about three-quarters open, and we shall employ the values: 0.44 line per ampere-turn per centimeter of "embedded" length, and 0.40 line per ampere-turn per centimeter of "free" length.

But the winding—so far as relates to the estimation of its inductance—is equivalent *not* to 8 coils of 10 turns each (*i.e.*, to one 10-turn coil per pole), but to 4 coils of 20 turns each, that is, to one 20-turn coil *per pair of poles.*

The motor is for 550 terminal volts, and the stator (primary) windings are Y-connected, there being, therefore,

$$\frac{550}{\sqrt{3}} = 318 \text{ volts per phase.}$$

$$2 \times \text{reactance per phase} = 0.592 \text{ ohm.}$$

Amperes at standstill and normal primary voltage for resistance less windings $= \frac{318}{.592} = 536$ amperes $= A$.

CALCULATION OF THE MAGNETIZING CURRENT.

Primary voltage per phase (E)	318	
Turns in series per phase (T)	80	
Periodicity in cycles per second (N)	40	
Flux per pole (E = 4.2 x T x N x M x 10^{-8}) (M)	2.37	megalines
Net length laminations between flanges (λ)	25.4	centimeters
Diameter at air gap	102	centimeters
Polar pitch (τ)	40.2	centimeters
Stator slot pitch	2.68	centimeters
Rotor slot pitch	2.23	centimeters
Stator slot opening	0.9	centimeters
Rotor slot opening	0.8	centimeters
Exposed iron at stator surface	66	per cent.
Exposed iron at rotor surface	64	per cent.
Mean percentage exposed iron (p)	65	per cent.
Mean cross section exposed iron per pole at air gap ($\lambda x \tau x p$)	660	sq. cms.
Correction factor for spreading of lines in gap	1.20	
Corrected mean cross section of air gap	790	sq. cms.
Average air gap density	3000	
Maximum air gap density (1.7 x average density)	5100	
Actual radial depth of air gap	.32	centimeters
"Equivalent"* depth, air gap	.35	centimeters
Required total magnetomotive force	1430	amp.-turns
Required for one phase	715	
Turns per pole per phase	10	
Maximum current per phase	71.5	amperes
R.M.S magnetizing current per phase	50	amperes = B

C. in Behrend's Formula $\sigma = C\frac{\Delta}{\tau}$
Completely Closed Slots
Wide Open Slots
Δ = Radial Depth of Air Gap in m/m.
τ = Polar Pitch at Air Gap in m/m. (i.e., τ is the Gap circumference divided by No. Poles)
λ = Net Length of laminations between flanges in m/m.
Cos. φ = 1/(1+2σ)
Ratio of λ to τ

FIG. I.

"Diameter of Circle" (in amperes) $= A - B = 486$ amperes.

$$ó = \frac{B}{A-B} = \frac{50}{486} = .103 \; cos \; \phi \; 0.83.$$

Now, it is evident that in Behrend's formula,[4]

$$ó = C\frac{\Delta}{\tau}$$

it is assumed that the inductance is directly proportional to the "embedded" length alone. We know from the above method, which takes clearly into recognition the effect of the "free" length, that it is only the inductance of the so-called "active" portion of the winding that is thus directly proportional to the "embedded" length. The inductance of the "free" length is directly proportional to τ. Hence, the total inductance decreases with increasing values of τ much less rapidly than is shown by Behrend's formula, and may ultimately even increase with increasing values of τ.

Nevertheless, Behrend's formula, in virtue of its great simplicity, permits of a much more rapid and satisfactory pre-determination of ó than is practicable by the method of working from the inductance as expressed in lines per ampere-turn per centimeter of "free" length and "embedded" length, owing to thus avoiding the necessity for an independent pre-determination of the magnetizing current. It is only necessary to employ suitable constants for C, and those given in Table II have been so chosen as to give results in fair agreement with those obtained by working from the values in Table I.

TABLE II.—VALUE FOR C IN BEHREND'S FORMULA FOR

$$\sigma = C\frac{\Delta}{\tau}$$

Net length λ of core between flanges in % of Pitch (τ).	Wide open slots.	Completely closed slots.
150	6.0	12.5
140	6.2	12.6
130	6.4	12.7
120	6.7	12.9
110	7.1	13.1
100	7.5	13.4
90	8.2	13.8
80	8.8	14.3
70	9.5	14.8
60	10.3	15.4
50	11.3	16.1
40	12.2	16.8
30	13.5	17.7

These results are plotted in the curves of Fig. 1, and constitute a useful basis for the calculation of ó.

A Record for Jablochkoff Candles.

A Calcutta correspondent of the London *Electrician* says that an installation of Jablochkoff candles at Calcutta has just been superseded by enclosed arc lamps after more than 22 years of service. The installation was put down some time in 1880 or 1881 to light the grounds of the Eden Gardens and gave admirable service up to November 14 of last year, when a modern plant was put in. The original installation consisted of some 30 lamps, the wiring being carried in iron pipes to the engine house close by. After about a year the cables developed faults and had to be abandoned, and new cables were laid in teakwood troughs run in solid with pitch. To this day they are still good. There is no telling how long the old arrangements might have been adhered to had not one of the boilers been finally condemned by the inspector. There are a few more lamps of the same era still working in Bengal.

[1] Of course this has in a general way been recognized by numerous designers—see, for instance, a review of Behrend's treatise, contributed to *Elektrotechnische Zeitschrift*, 1903, Heft 24, by M. Breslauer—but it is doubtful whether it has been recognized that the percentage is so high.

[2] "The Induction Motor," New York, ELECTRICAL WORLD AND ENGINEER, 1901.

[3] This example is an extreme instance of the preponderating effect of the inductance of the end connections. A decidedly better motor, especially as regards higher power factor, would have resulted from the employment of a smaller diameter and a greater length of laminations between flanges.

[*] That is, making allowance for reluctance of teeth and core in the manner suggested by Kapp in Elektromechanische Konstruktionen."

[4] It would appear that the simplest formula which could really be said to approximately represent the facts, would be of the form

$$\sigma = k\frac{\Delta(\Delta + k^1)}{\tau^2}$$

k and k^1 being constants proportional respectively to $\frac{\lambda}{\tau}$ (where λ is the length of lamination between flanges), and to the depth of the slots. But it is decidedly preferable to use as simple a formula as practicable, and it is thought that Behrend's original formula $\sigma = C\frac{\Delta}{\tau}$ with the correction for the free length set forth in Table II and Fig. 1, constitutes a fairly satisfactory basis.

The New Automatic Telephone Exchange at Grand Rapids, Mich.

BY EDWARD J. HART.

The new automatic exchange of the Citizens' Telephone Company, of Grand Rapids, Mich., was "cut over" at 12:30 noon, Saturday, January 9. The complete exchange of more than 5,000 telephones was thrown into operation at that time, and only seven minutes of time were required to cut off the old manual exchange and switch in the new one. The occasion marked an epoch in the progress of the telephone industry. In point of number of telephones in operation, the exchange is the largest automatic system in the world, and the officials of the company that installed the automatic exchange state that it is the first time a large automatic plant was ever cut over in one operation; the usual practice being to cut in banks of 1,000 telephone switches according as they are ready for operation. The same officials stated that it may be a lifetime before a similar cut over is made, of 5,000 automatic telephones at one time, since conditions are usually so different, and it is usually so much more desirable to switch in fractional portions of the exchange at a time. Of the 145 telephone operators in the employ of the Citizens Company, 48 were retained to fill positions in the toll line operating room and at the information desks, and the others left their switchboards as they "died" and went out into the world to seek other employment—a regretful incident of the change to the telephone company.

The Citizens Telephone Company of Grand Rapids is essentially a home institution, owned by more than 1,200 Grand Rapids stockholders. Aside from the local exchange, it operates a large number of others in towns and villages of the state, and reaches 250 exchanges and toll points within 50 miles of the city and a large number in all parts of western and northern Michigan. It connects also with a large number of telephones in farmers' homes, including two exchanges of 60 each of "farmers'" telephones. The company was organized in May, 1895, and incorporated the following September. Its service was established in June, 1896, with 832 telephones. Its capitalization then was $100,000, but it boasts now of an authorized capitalization of $2,000,000, of which $1,400,000 is paid in, and stock is still selling. With its local service and the companies in which it is interested, it controls 15,000 telephones.

The new automatic system is installed under the Strowger patents, by the Automatic Electric Company, of Chicago. The contract for the system was entered into in December, 1902, and last May the erection of a new exchange building was begun, which was completed in November. It is centrally located, not far from the site of the old exchange, and is a model telephone building in every respect. The work of installing the automatic apparatus and connecting the exchange lines through the new system instead of directly to the old was taken up at once and hurried along by a large staff of electrical workers with no delay.

As already stated, the Grand Rapids automatic exchange is the largest in the world as regards the number of telephones in service. The New Bedford and Fall River, Mass., exchanges, the first installed in this country, are operating respectively with 1,400 and 800 subscribers. An exchange at Dayton, Ohio, opened recently with 2,800 subscribers, and one in Chicago with an ultimate capacity of 10,000 subscribers is now operating with about 3,000, while there are a few smaller exchanges in various parts of the country. But Grand Rapids cut in 5,300 telephones, including instruments on party lines and those in outlying districts accommodated on a "rural switchboard."

The new exchange building is a handsome structure of red brick with stone trimmings, 68 by 143 ft. in dimensions, and two stories high, with a finished basement that makes it practically a 3-story building. The basement is of masonry, finished in cement and provided with cement floor. It is divided into a large supply room and a furnace room, and out of it opens the tunnel through which the cables enter the building. The tunnel is a remarkable piece of subterranean engineering work. Many feet under the ground it stretches from the basement to a point 250 ft. distant where is located the manhole in which the extensive conduit system terminates. It is 7 ft. in height and nearly 5 feet in width. Along the walls are carried 36 permanent cables, each of 200 to 400 pairs of conductors. The tunnel is electrically lighted and a switch at the basement entrance controls the illumination.

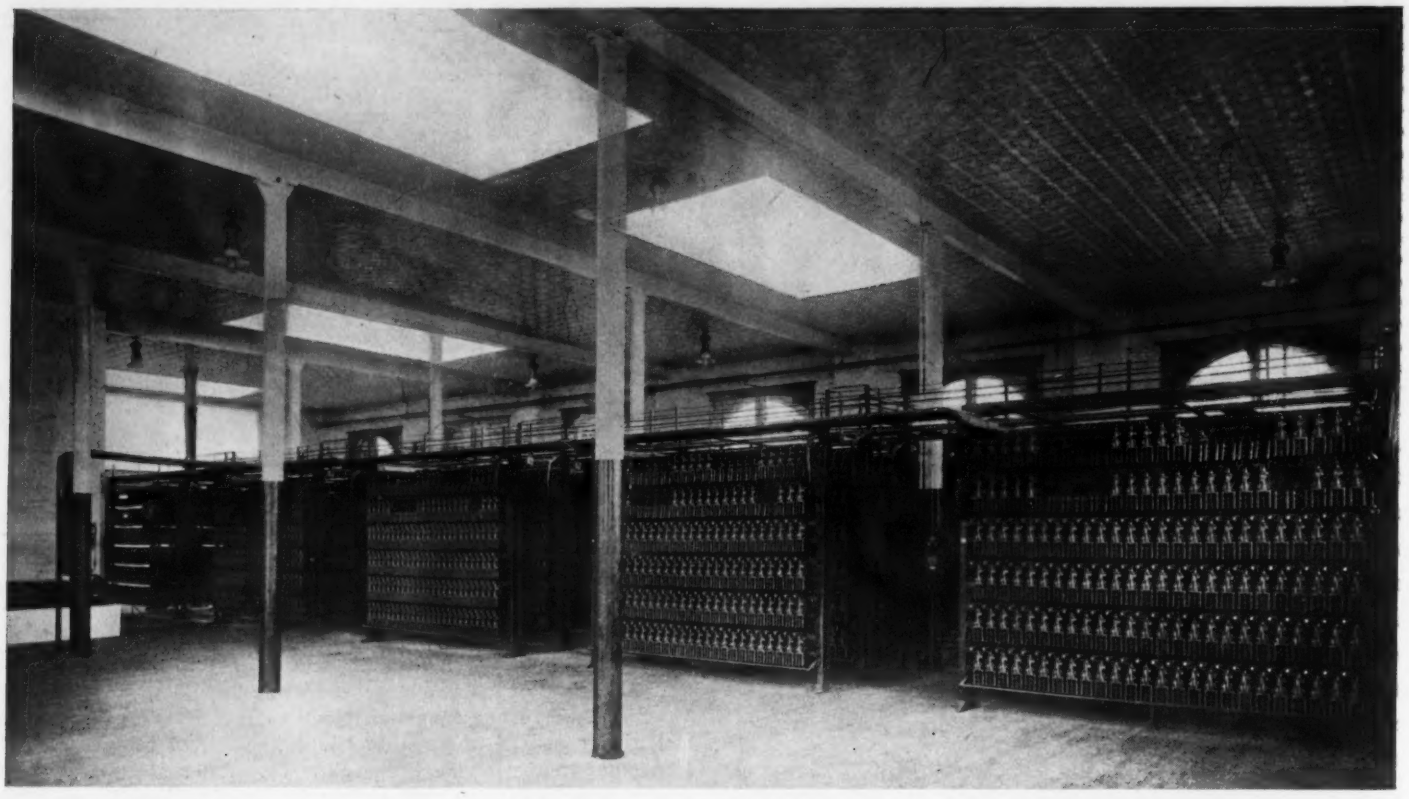


FIG. 1.—INTERIOR OF SWITCH ROOM, GRAND RAPIDS EXCHANGE.

The first floor of the exchange building is given over to the general offices, private offices of the company officials, draughtsmen and electricians, and to a spacious repair shop in the rear. The offices are fitted throughout in antique oak with white finished walls, and the general offices directly in front of the main entrance are equipped with furniture of the bank variety. Everything is of a modern and practical type and convenience appears to have been the keynote in its selection. The shop in the rear is a large room equipped with machine tools, work benches and the various appliances and accessories with which machinists, carpenters and electricians work. The company does not only its own repair work, but that of the smaller exchanges on its toll lines; and a large staff of repair men is employed. The stairway leading to the floor above is convenient to all

the departments down stairs, and also opens upon a side entrance to the building for the use of the toll room operators and others employed on the second floor. The latter floor is apportioned to the exchange or switch room, the toll operating room, women employees' club rooms and inspectors' room. The stairway on this floor opens upon a long corridor which separates the switch-room from the other deaprtments.

Entering the switch-room, one confronts the desk of the wire chief,

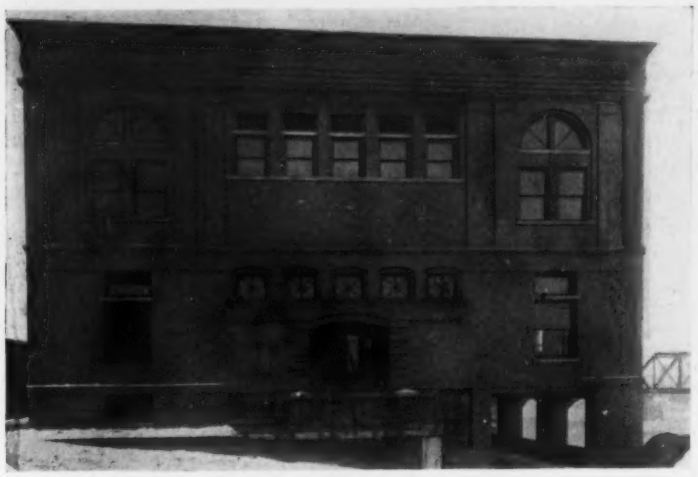


FIG. 2.—EXTERIOR OF EXCHANGE BUILDING.

who is the head "trouble man." At one end of his desk is a small window which opens into the inspectors' waiting room, the convenience of which arrangement is obvious. Near by is the main distributing board, reached on one side by the cables from the tunnel and on the other by the switch-room cables. It is a board of the most modern design, and the terminals are arranged in such a compact way that it is only 10 ft. in height and about 12 ft. in width. It is made in sections, and its ultimate capacity is practically unlimited.

The small cables from this board do not lead directly to the banks of automatic selector switches, but first cross the hall to the tool line operating room, where thew are tapped upon the toll room exchange switchboard. Again they cross the hall to the switch room and find their way to the subscribers' selectors. Here are provided five banks or frames of selector switches, or selectors, with 1,000 to each bank,

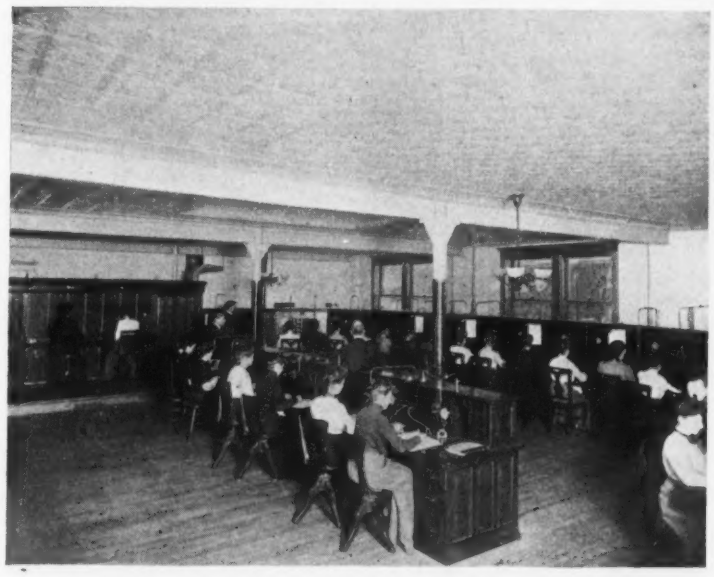


FIG. 3.—TOLL LINE OPERATING ROOM.

and additional ones known as trunk selectors. The frames are of heavy angle iron and hardwood. The lower four rows or 100 selectors, and the upper ones are the trunking selectors. Of course, in the Grand Rapids exchange, as in any automatic exchange having more than 999 telephones and consequently having numbers of four digits, two sets of trunking selectors are necessary. There is ample floor space for at least three more banks of 1,000 selectors, so that the exchange has a capacity of 8,000 telephones, and by the removal of some partitions even this could be increased.

Just in front of the main distributing board and between it and the selector banks is the generating plant with its switchboard. One generator is provided to charge the storage batteries used in the toll service, the motor side operating on the Edison 220-volt circuit.

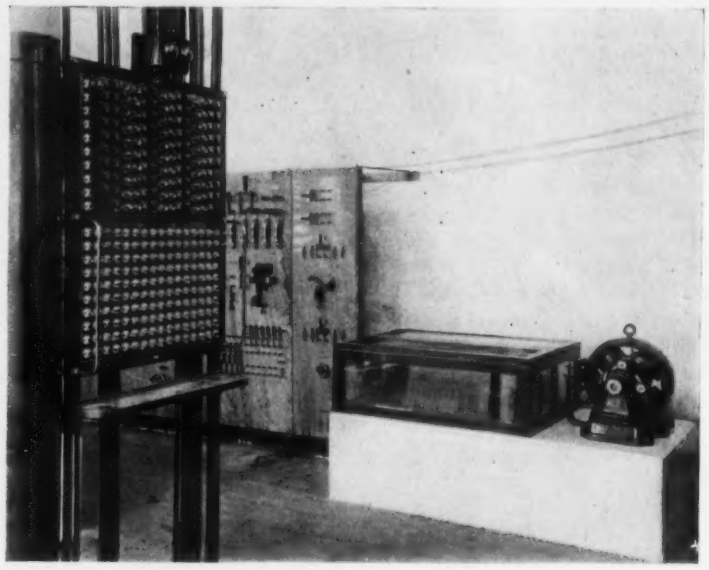


FIG. 4.—AUTOMATIC TELL-TALE BOARD AND CURRENT INTERRUPTERS.

Two other rotary converters are provided for charging the storage battery plant that operates the selectors. In addition to these, two sets of motors and generators provide the alternating current for the magneto bells, and a third of similar style but smaller is provided for the night service. An important piece of apparatus in this department is the interrupter and its reserve duplicate. These are

FIG. 5.—TEMPORARY WORK TO FACILITATE THE CUT-OVER.

contained in a glass case, and are revolving commutators of special design that furnish the intermitting or pulsating storage battery current that operates the rotating, trunk-selecting arms of the selector switches. The interruptors contain also a device which produces the current that gives the "busy" test, or "busy buzz," as it is called. Small electric motors revolve the commutators of these interrupting machines. A handsome marble panel switchboard is provided nearby upon which are mounted the switches, volt- and ampere-meters, lightning arresters and other accessories of the generating plant. A

"tell-tale" board stands not far distant from this, upon which are miniature lamps and a magneto bell to detect and locate grounded lines. At a glance the switch room employees can tell in what set of 100 selectors one may be found in which the delicate protector fuse is blown.

Across the hall is the toll room, one of the prettiest departments of the whole plant. Here are switchboards for a variety of purposes. The contract for this apparatus was placed through the Automatic Company, but the switchboards were manufactured by the Kellogg Switchboard Company. First in the line is the exchange switchboard, upon which is spread out a system of contacts representing the entire city exchange. Adjoining this are three recording operators' positions, and next to that is the "through" board, on which one toll line is connected with another. Continuing down the side of the room from the "through" board are ten toll operators' switchboards, upon which the toll lines come in. Calls from outside come over these, and are "trunked" to the main exchange switchboard, where the subscriber is called. On the other hand, calls from subscribers for toll lines are received at the recording operators' boards, recorded, and trunked to the toll line boards. The telephone instruments in use are provided with calling dials that have finger-holes not only from 0 to 9, but an additional one for "long distance." A turn of the dial to this point gives a connection with one of the recording operators' boards. It is the first time the Automatic people have installed telephones provided with this special long distance call.

At the end of this toll room is the "rural board." This is provided to accommodate subscribers located in the outlying districts or a long distance from the exchange. It appears that the automatic service does not operate so well over very long circuits, and a complete automatic system in a large city would mean a number of branch exchanges with trunking systems. The board has a capacity of 132 rural subscribers, but there are not nearly that many located so far away from the central exchange that they lose the advantage of the automatic service. These few have "Rural 25" or "Rural 30," or some other number affixed to their regular number in the directory, and their service is in part through this board.

In addition to this array of switchboards, the toll room is provided with three large double desks arranged to accommodate six persons. They are the positions of the toll traffic manager and five information clerks.

Adjacent to the toll room is a locker room for the young women employees, in which are provided black enameled lockers of ex-

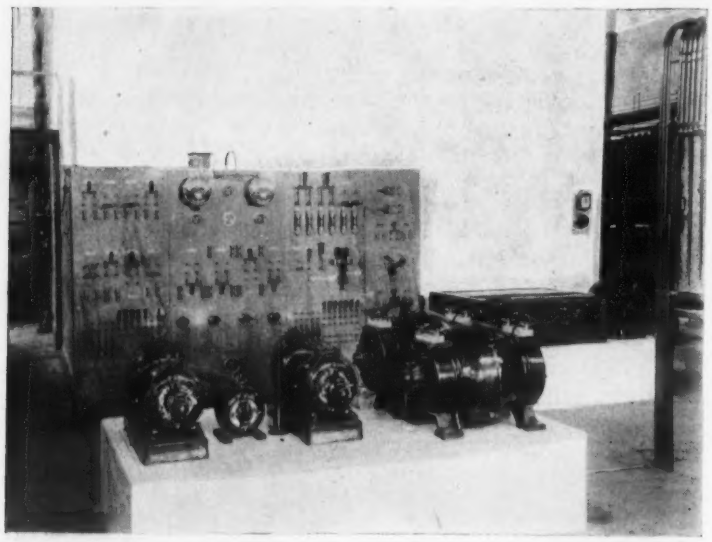


FIG. 6.—GENERATING APPARATUS AND SWITCHBOARD.

pended metal. It may be noted at this point that lockers of the same style are provided in the inspectors' room and in the shops and offices. Passing through the women's locker room one reaches a beautiful suite of rooms elaborately furnished and fitted out as club rooms for the women employes of the company. A reception and dining room are finished with woodwork of dull black oak and walls of rich green. The walls are hung with pictures of high colored poster style, framed to match the finish of the room, and polished wood floors are covered with rich rugs. The furniture is of dull black oak, and is of the quaint and artistic design so popular for "dens," beer rooms and the like. Some of it is richly upholstered with leather cushions. Handsome electric chandeliers and fixtures of odd design match the general effect. The dining room is provided with a china closet well supplied with china and cut glass, and just off this room is a kitchen with its pantry and a large gas range. It is the plan of the company to keep the canisters of the pantry filled with tea, coffee and other beverages, and a matron will be in charge of this department.

The method by which the inauguration of the new system was effected and the "cut-over" made in the short space of seven minutes,

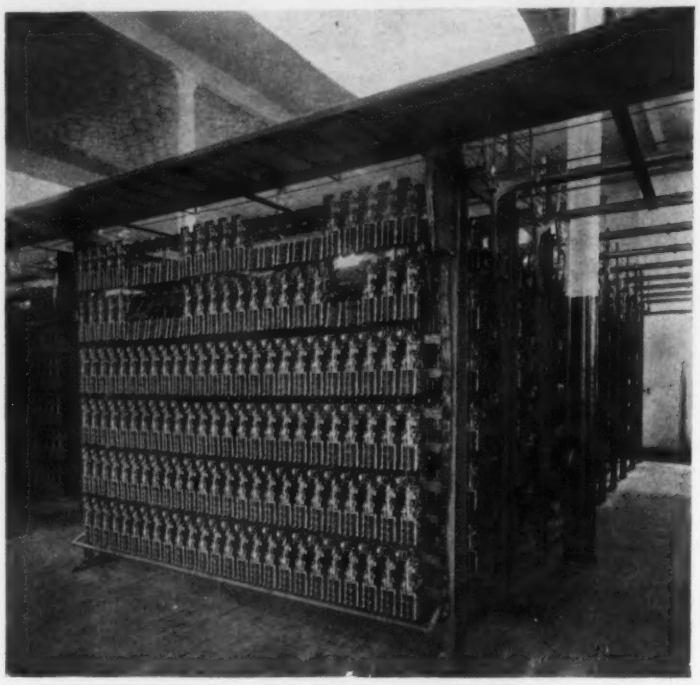


FIG. 7.—ONE OF THE BANKS OF SELECTOR SWITCHES.

is quite interesting. For some weeks prior to the "cut-over," Citizen's telephone users had been talking through the new exchange, although not using it. The conductors of the necessary number of temporary cables were tapped to the terminals of the main distributing board in the new exchange. These cables were conducted through the tunnel and a temporary conduit system to the old exchange. The terminals of the new distributing board are provided with spring contacts that may be separated by the insertion of an ordinary wooden toothpick, and this was done. Thousands of toothpicks were arranged in these terminals. When the "cut-over" was made the toothpicks were withdrawn and the temporary wires to the old exchange were cut off.

Grand Rapids had long been waiting for the new system and it seems that most of the subscribers were at their telephones waiting to try them as soon as the system was switched in, which it was announced would be at 12:30 sharp. Fifteen minutes after the system was cut in, General Superintendent Keith, of the Automatic Company, estimated that 1,700 switches existed or twice that many telephones were in use, simultaneously, out of approximately 5,000 lines connected to selectors. The largest number of simultaneous connections that was ever counted in the old exchange was 204. For the few days that have elapsed since the inauguration of the automatic service it had worked splendidly, and Grand Rapids telephone users have nothing but words of praise for it. Officials of the local company say the "trouble" is not nearly what was expected and what had been provided for, and that it amounted, even during the first two or three days, to little more than the normal under the old system. Some difficulty comes from the fact that many numbers—about 1,200—were changed; four digits are necessary to each automatic number, to insure four turns of the calling dial, and 5,000 was added to all the old numbers from 1 to 999. Some other numbers were altered for various reasons.

The new telephone exchange building cost the company $60,000. The cost of the automatic exchange and apparatus is not given out by the officials, but it is believed by some competent to judge that the price approximated $200,000.

FIG. 1.—EAST END AND NORTH FAÇADE, PALACE OF MACHINERY.

The Westinghouse Service Plant at the St. Louis Exposition.

Although a large amount of power for the use of the Louisiana Purchase Exposition will be derived from exhibition apparatus in Machinery Building, with boilers located in the Steam and Fuels Building, near by, it was decided by the Exposition authorities that it would be best for the Exposition to erect under contract a service power plant for the use of the Exposition, which would be more directly under the control of the Department of Works than exhibit apparatus could be. Such a plant is needed for the service of the Exposition, and it is essential that it should be completed and in operation before the Exposition opened without any of the uncertainties attending the completion of exhibits. It was finally decided to award the contract for such a plant, with a capacity of 8,000 kw, to the Westinghouse Electric & Manufacturing Company. This contract covers the entire power plant equipment with the exception of the buildings and stacks. The engines and generators will be placed in Machinery Hall in a space set aside for the service plant. The boilers will be located in the Steam and Fuels Building, 100 ft. distant, which is the building in which all boilers and gas-producing apparatus will be placed.

Although this is a service plant in name, it will, of course, be an interesting exhibit. While there will be nothing radically new in its essential elements, it will represent good modern power house engineering practice. The reasons urged for the award of this contract to the Westinghouse Electric & Manufacturing Company were that, on account of the many allied Westinghouse interests, it would be possible for this company to handle a large part of the contract without going outside of the Westinghouse companies and chances for coherent design and prompt completion were better than if the contract were awarded to several companies. Thus, the steam engines will be furnished by the Westinghouse Machine Company, and the engineering and construction of the plant will be done under the supervision of Westinghouse, Church, Kerr & Co. The plant will contain four units of 2,000 kw each. These will be 25-cycle, three-phase, 6,600-volt generators, direct-connected to Westinghouse Corliss engines. The generators will weigh, without the bed, 132,000 pounds, and with the bed 190,000 pounds. The efficiency guarantee is 96 per cent. at full load, 95 per cent. at three-fourths load, and 93 per cent. at one-half load. They will operate at continuous full load with not over 35° C. rise in temperature. The engines will be Westinghouse vertical, cross-compound, condensing, Corliss, running 83 r.p.m. They are rated at 2,800 hp and have a maximum overload capacity of 5,200 hp, the latter capacity being reached at three-fourths cut-off in the low-pressure cylinder. The cylinder diameters are 38 and 76 in., with 54-in. stroke. The shaft will be hollow forged steel 31 in. in diameter. In addition to the fields of the generators, the engine will have a fly-wheel of 175,000 pounds weight. The total weight of the engine is 750,000 pounds. It is guaranteed to operate on 13½ pounds of steam per indicated hp-hour. Water for condensation will be supplied from a cooling tower having fans driven by electric motors, to furnish air circulation.

The boilers in the Steam and Fuels Building which will supply

FIG. 2.—INTERIOR OF MAIN ENTRANCE, PALACE OF MACHINERY.

this plant are 16 in number, of 500 hp each, of the B. & W. water tube type. Smoke flues will be placed under the floor and led to the stacks built by the Exposition. In addition to the natural draft, fans will be installed to produce artificial draft when needed, in accordance with Westinghouse practice. Roney mechanical stokers will be used under these boilers. That part of the Machinery Building devoted to the service power plant is spanned by a 40-ton traveling crane. Besides the main units, there will be three 80-kw exciter units, any one of which is sufficient for the entire power plant. These units will be direct-connected to vertical cross-compound, condensing, West-

inghouse engines running 300 r.p.m. The weight of a unit complete is 38,000 pounds.

A Westinghouse switchboard will be installed consisting of three exciter panels, four generator panels, two main load panels, two incoming feeder panels and twenty-four outgoing feeder panels. The incoming feeder panels are for the current which is to be purchased by the Exposition from the Union Electric Light & Power Company. The two load panels will pass the entire load, one panel being used for each of the two sets of bus-bars. Solenoid-operated oil switches are to be used for the high-tension alternating current, and these will be controlled in the usual manner by low-tension circuit, with switch handles on the various panels. On each generator panel will be three switches, one controlling an oil switch connecting the generator with one set of bus-bars, the other connecting it with the other set of bus-bars, the third being in the generator leads in series with the two just mentioned. The switches will be equipped with time limit release for automatically opening the circuit. Each generator panel will have one power factor indicator and three ammeters. Each feeder panel will have three oil switches, two of which are in multiple for connecting to either set of bus-bars, and the third in series with the other two, or the reverse of the generator switching arrangement. Each feeder panel will have also three ammeters and one integrating wattmeter.

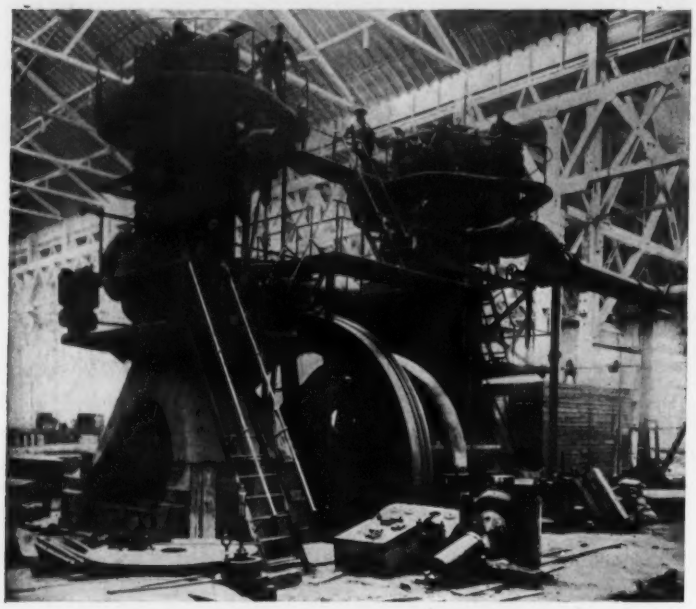


FIG. 3.—2,000-KW DIRECT-CONNECTED GENERATOR, PALACE OF MACHINERY.

FIG. 4.—PORTION OF FAÇADE, NORTHEAST ENTRANCE, PALACE OF MACHINERY.

Although not a part of the service plant, another interesting contract which this company is filling for the operation of the Exposition is for the 2,000-hp induction motors to be direct-connected to Worthington centrifugal pumps, to supply the Cascades with 90,000 gallons of water per minute. Thhs will be a remarkable installation, not only on account of the size of the induction motors, but on account of the size of the pumps and the high head to which water must be raised, which is approximately 150 ft.

Recent Electrochemical Developments.

FURNACE INVENTIONS.

There is great activity at present in resistance furnace design with an intention to obtain a perfect regulation of temperature and a uniform heating effect. This development is combined with a tendency to apply the electric furnace to processes requiring relatively lower temperatures than heretofore. This means an extension of the use of the electric furnace which was formerly restricted to the production of extremely high temperatures. An example of this development is a method of making carbon articles for which a patent was granted on January 12 to Mr. E. G. Acheson, of Niagara Falls. In manufacturing carbon articles, the customary method is to take some suitable carbon—such, for instance, as ordinary coke, coke produced from petroleum, or lampblack—in a finely subdivided form and mixed with tar or another appropriate binding material and moulded under pressure into the desired forms. These forms are then placed in a gas or coal-heated furnace and slowly raised in temperature until all of the contained volatile hydrocarbons have been driven off, leaving the articles in a solid, dense and coherent condition, for use as electric light points, electrodes, dynamo brushes, etc. In the last step of this process, as the articles are massed together in large volume, much time is required for their efficient packing and considerable difficulty is encountered in obtaining a uniform elevation of temperature throughout the several articles, and the failure to do so frequently results in serious warping or cracking of the goods treated.

Mr. Acheson designs his electric furnace in such a way as to produce a uniform elevation of temperature throughout the mass of the carbon article. In his furnace he is also able to attain a considerably higher temperature than can be obtained in a gas or coal-heated furnace, so that while he does not reach the temperature required for changing the carbon into graphite, yet the temperature is sufficiently high so as to polymerize the carbon and increase its density, electric conductivity and resistance to chemical action. The carbon articles are embedded in a resistance material of granular carbon or a mixture of granular carbon and silicon, etc. The carbon articles to be heated are placed with their longest diameters at right angles to the flow of the current. The intention is not to produce heat in the carbon articles as the result of passing the current through the articles, but rather to produce the heat in the packing material separating the carbon articles. The result is a very uniform raise of temperature.

Three patents have been granted to Messrs. Le Roy W. Stevens and Bernard Timmerman, of Chicago, for an electric furnace for making carbide or the like. The invention contemplates essentially a down-draft furnace in which the falling material is preliminarily heated, the resultant gases being drawn off at a high temperature and used for any desired purpose, an auxiliary chamber into which the material is charged and again treated, the resulting gases from this second treatment being conducted to the main flue, and delivered therein near its top at a high temperature, increasing the temperature and the chemical reaction.

STORAGE BATTERY ELECTRODE.

A patent was granted to Mr. R. Hager, of Halensee, Germany, for a Planté electrode, comprising separate plates coaxially arranged. Each plate is composed of a series of channel-shaped plates arranged one above the other. Each channel-shaped plate is provided with a slit extending transversely of the channel. The object is to prevent injurious tensions being set up during charging and discharging which would cause the active material to break off.

Institute Meeting in Chicago on Storage Batteries.

The Institute meeting held January 12 in Chicago was presided over by President Arnold. Mr. Lamar Lyndon's paper on "The Comparative Behavior of Floating and Booster-Controlled Batteries on Fluctuating Loads," presented at the November meeting in New York, was abstracted by Mr. J. M. S. Waring, of Chicago. The discussion was participated in by a number of storage battery men and served to show the value of a storage battery, not merely from an engineering standpoint, but as an investment as well. Commercial utility was the keynote of the discussion.

President Arnold, in introducing the first speaker, called attention to the wonderful strides made in storage battery engineering in the last eight or ten years and the recognized place the storage battery now occupies. Mr. George Damon, managing engineer of the Arnold Electric Power Station Company, described two installations which have been made by him. The beneficial effect on operation of electric roads was clearly proved and the investment under such conditions shown to be about the same as if no battery had been installed. Mr. Joseph Appleton, manager of construction of the Electric Storage Battery Company, considered the best methods of operating batteries to give results which will yield the best return on the investment, or, in other words, the maximum commercial efficiency. The battery which does the most work is not always the one which gives the greatest commercial efficiency. Continuing, he stated the conditions under which a battery for a railway system may be installed, to be as follows: Increase of capacity of the generating plant; evening up the load on the generator plant to give greater economy of operation; saving of copper and maintaining proper potential on the line.

It depends largely for which of these purposes a battery is installed, as to where it should be located, and how it should be controlled. In addition to this, the location of the battery will depend a great deal on the price of real estate and cost of attendance. All of these things must be taken into consideration before it can be decided where to place the battery. It should also be determined what proportion of the total load the battery should take; this will be governed entirely by local conditions. For example:

Where a generator plant is operated by steam, the capacity of the boilers and units should be taken into consideration, or where current is purchased from a large system, operated by either steam or water power, the terms of the contract under which the power is bought will frequently determine what the battery should do. To illustrate what is meant, two cases were mentioned. One is the Inter Urban Road between Seattle and Tacoma, which is operated from four sub-stations, the power being bought under contract from the Snoqualmie Falls Power Company. In each of the sub-stations there are two motor-generators, of 300-kw capacity; each one of these with the battery in each sub-station is sufficient to run the load under ordinary conditions. The economical maximum load on each of these stations, according to the terms of the contract, is about 600 amp., the actual load varying from 200 to about 1,800 amp. The batteries and boosters in these stations are so adjusted that the battery will not discharge to any extent, until the load on the generator reaches 600 amp., after which point the battery and booster practically take the additional load. These conditions naturally do not show a very good load curve as far as the battery is concerned, but yet it is working under maximum commercial efficiency.

An illustration of the opposite condition can be found in the plant of the Oakland Transit Company, which operates a system of five car trains, running to a ferry, landing in Oakland from San Francisco. In this case the load on the station varies from zero to 2,600 amp. and by the use of the battery and booster the system can be operated by one 600-kw steam-driven generator, the load on which is maintained between 800 to 900 amp. all the time. These two plants illustrate clearly the operation of a battery where close regulation is advisable, and also where it does not pay to get close regulation.

In these days when electric railways are extending so rapidly and the growth of interurban service is so marked, new conditions are arising for the power plants and sub-stations operating such systems. We find two kinds of fluctuations, one due to the local service, where the fluctuations are frequent and comparatively small, and one due to interurban service where the fluctuations are periodical and very great. In such a case it does not pay to adjust the battery and booster to take all the small fluctuations, for if this was done a battery large enough to take all the heavy fluctuations due to the interurban service would mean too great an investment to be profitable.

The average load on such stations is usually more than the local service load, and therefore a portion of the interurban fluctuations can be safely and economically carried by the power house or the sub-stations. The battery, in this case, gives its best results commercially by taking that part of the load which would overload the sub-station too heavily. The rapid growth of interurban service means a greater use of batteries, as without them it is necessary to install generator machinery sufficient to carry the maximum interurban load, while the average is very much less. Generally speaking, if the battery is to relieve the station of fluctuations, it should be located at the station, and if it is to save copper or maintain proper voltage on the line, the battery should be located out on the line.

Each year finds the use of storage batteries increasing very rapidly, and this is due largely to the fact that the proper use and operation of a storage battery which gives the maximum return for the investment, is being understood. The life of a storage battery is practically proportional to the number of kilowatt-hours taken out of it, and consequently the maintenance of the battery can be kept down to a minimum, by only using the storage battery to take part of the load which pays. In other words, by using the battery to give the maximum efficiency of the combined system, and not merely to straighten out the load curve irrespective of the cost of current at different times and under various conditions.

Mr. John I. Beggs, of Milwaukee, emphasized the commercial aspect of the subject. He heartily concurred in Mr. Appleton's statements and considered that the storage battery has often suffered because it has not always been installed with a view to best meet existing conditions. Mr. Beggs stated that he had been forced to install a battery at Milwaukee a few years ago because of the advent of the steam turbine at a time when he was considering making an investment of $4,000,000 for a new power house. The conditions under which the battery had been installed were severe inasmuch as it had to be used either for street railway work or on an Edison three-wire system, or both at once. The battery had proved of inestimable value and an actual necessity, although the price would lead one to believe it to be a luxury.

Mr. Ernest Lunn, of the Chicago Edison Company, in discussing Mr. Lyndon's paper, considered the storage battery more especially from the operator's standpoint. He said that it would be interesting to know to what extent changes affect the behavior of a battery since its characteristic changes with age, with variations of temperature, specific gravity, and condition of plates. The facts might be different in the case of a battery floating near a station from that at the end of a long feeder. A rise in temperature would cause the battery characteristic to approach the horizontal line and the battery would give a greater discharge for a given drop in pressure than if the temperature remained constant. The characteristic with most batteries would likewise gradually approach the horizontal as the battery ages, further increasing the charge and discharge for variations in line pressure. In discussing Mr. Lyndon's statement that "In any battery used for regulation, it is necessary that the input approximately equal the output, otherwise the state of battery charge is changed and the efficiency of the regulation decreased," he stated that it was quite necessary to have about ¾ full charge if the best results from the battery are to be expected, or at least to have some fixed state of charge. A battery at ¾ full charge will discharge at a higher rate for the same drop in pressure than it will at, say, either full charge or half charge. It is of importance then to be able to adjust the voltage and load, so that the battery may be in condition to float at the proper point of charge, else the desired results will not be obtained, due to the change in the battery characteristic. Batteries, too, are not all alike in regard to initial and final voltage; especially is this true of batteries of different manufacture. Some means, therefore, to compensate for irregularities and unavoidable variations should be provided.

The second feature of the evening was the paper on "Gas Power for Central Stations," by Mr. J. R. Bibbins, an abstract of the paper being read by the author himself. Mr. John I. Beggs, in opening the discussion, stated that personally he was more especially interested in what had been accomplished in the way of large gas engine units. As compared with steam engines of small size, as usually operated, the gas engine no doubt is far more economical, and he was ready to concede all that was claimed for it, and more, too. The units and results considered in the paper, however, were not such as to admit of predicting what these would be with, say, 5,000-hp units. When a company must sell current for as low a price as 1 cent per

kilowatt-hour at the switchboard, small units, whether of the reciprocating steam engine or the gas engine, are out of the question. There was a question in his mind as to whether the steam turbine or the gas engine will eventually prove the more economical. Three or four years ago he had, as already stated, delayed the building of a power house to cost $4,000,000, as the steam turbine was then looming up. Now he was disposed to further delay action on account of the advent of the gas engine. He had received a proposition to install a 5,000-hp gas engine, a size to be considered. The men in charge of the financial operation of great properties had to contend with not only such problems, but others as well. Milwaukee is seeing the building of a coke oven plant which will turn out fuel gas as a by-product. The competition which such an enterprise will develop may prove serious, and there is a question in his mind whether it would not be profitable to buy the entire output of the plant for a gas engine power plant.

Mr. George N. Eastman, of the testing laboratories of the Chicago Edison Company, compared the efficiencies of the various prime-movers emphasizing the greater economy of internal combustion engines. Mr. C. E. Sargent outlined the development of the gas engine and ascribed the lack of greater progress to the fact that the original patents had expired but recently. With the double-acting tandem horizontal engines now being put on the market, a uniform turning moment is obtained and a regulation as good as with the steam engine. Mr. W. L. Abbott, chief operating engineer of the Chicago Edison Company, predicted that if gas engine development in the next three years would be as rapid as that of the turbine in the same length of time, a great deal would be accomplished. He pointed out that whereas the steam turbine had been known for 2,000 years, the gas engine was a product of the last twenty years. Mr. C. H. Williams gave the result of his experience with small gas engine units at Madison, Wis. Mr. Bibbins, in concluding the discussion, made the point that if the showing in the case of small gas engine units is good, it is safe to say that large units will do as well if not better. He ascribed the lack of development in the past as due to a great extent to the lack of an improved gas producer. The question as to the relative value of the gas engine and the steam turbine was in reality foreign to the subject of his paper. In fact, the prime-mover should be chosen with a view to its suitability for any given set of conditions.

The meeting was one which showed the Chicago membership well alive to the subjects considered, and it was well attended. The next meeting will be held February 2 and will be devoted to a discussion of the important question of manual versus automatic telephone operation. Mr. Frank Dommerque will present a paper on "Commercial Aspect of an Automatic Telephone Exchange."

General Electric Foremen's Banquet.

The Foremen's Association of the General Electric Company held its second annual banquet at the Edison Hotel, Schenectady, N. Y., on the evening of January 9. At the conclusion of the dinner Mr. T. E. Leavitt, president of the association and toastmaster, called upon several gentlemen present to respond to toasts. Mr. E. W. Rice, vice-president of the General Electric Company, took as his theme "The General Electric Company at Home and Abroad." He referred to the history of the joint companies of the plant, mentioning the pioneer enterprise such as the Edison works and giving an idea of what each contributed to the work done by the larger plant. He also told of the work done by the branches in the other parts of the world, such as Japan, Egypt and India.

He delved into statistics and said that if all the buildings of the General Electric Company in the United States were joined in one structure 50 ft. in width they would extend from Schenectady to Albany, 18 miles. He further stated that the company employed between 18,000 and 20,000 men in the different works throughout the United States.

On the subject of incandescent lamps manufactured by the company in the last 10 or 12 years, he stated that no less than 125,000,000 had been turned out. To show that the stockholders of the company were not taking in all the profits made by the works, Mr. Rice said that the immense sum of $75,000,000 had been paid to their employees in the United States within the last 12 years, while the stockholders had received $15,000,000, but one-fifth of that sum, during the same time.

Mr. G. E. Emmons, general manager of the works, was next called upon and gave a retrospection on the company's work during the last year. He said:

"The business of 1903 was greater than that of 1902. This was due, however, to the fact that a number of old contracts were carried over, as the current orders received were not as great as in 1902. From the indications it looks as if the business would be light for the next few months, but will probably soon pick up."

He thanked the men for their efforts, giving them much credit and attributed much of the good showing made by the company to the work done by the foremen.

"During 1903," he said, "we spent much for new and improved machinery, for it is the policy of the company to do so whenever it is shown that it can thereby lessen the cost of production. Competition is very strong and in order to keep in the flock and lead competition, it is necessary to be constantly employed in introducing improved methods, improved machinery and any other change that would tend to lessen the cost of the output. Watch closely for economy, but remember it is economy to spend freely when a saving can thereby be effected."

"Electricity as Applied to Machine Tools" was the topic of Mr. A. L. Rohrer, superintendent of electrical construction. "At present," he said, "we have about 6,000 machine tools in the works, run by 900 motors. Six hundred and eighty-seven of these are driven by individual motors. In 1900 we had but 460 motors and even since 1902 the increase in our power is fully 30 per cent." In speaking of the arc lights which are used in the plant, Mr. Rohrer stated that no less than 2,000 of them were in use, fully as many as are employed to light an entire city of 300,000 people.

Among the other speakers who were called upon were E. B. Raymond, foreman of the testing department, who spoke upon "The General Utility of Electricity as Applied to Modern Industries"; J. Riddell, who addressed the men on "High Speed"; L. Gibson, superintendent of the producing department, and B. Morrow, foreman of the testing department, whose subject was "What I Know About Water."

Radium Mines in London.

A cable dispatch from London says: "The possibility is suggested that London may become the center of a peculiar mining industry. There are houses somewhere within the metropolitan area whose foundations are imbedded in a precious substance, which, if it could be recovered, would be worth more than a whole street of houses. The very roads along which London's unwitting millions hurry about their daily business lie on artificial beds of radium, put down many years before the nature or value of the element was discovered. Sir William Ramsay is authority for the statement that a London firm of analytical chemists has thrown away for many years the by-products obtainable from pitchblende in the process of extracting uranium. The firm which thus unknowingly has flung probably many great fortunes to the wind is Johnson, Matthey & Co., Limited, of Hatton Garden, but, as one of the principals remarked the other day, radium had not been discovered at that time. "As a matter of fact," he added, "we actually paid, I believe, three shillings and sixpence a ton to have the stuff carried away in dust carts. It was used for leveling and laying out roads in the city and for filling in the foundations of houses." For twenty-five years the firm was engaged in extracting oxide uranium from pitchblende. The oxide was used mainly to color expensive glassware, to which it gave a yellowish-green fluorescent appearance. The use of uranium for this purpose has been long discontinued in favor of cheaper methods. Much of the pitchblende worked upon by Johnson, Matthey & Co. was obtained from the mines at Joachimsthal, Austria."

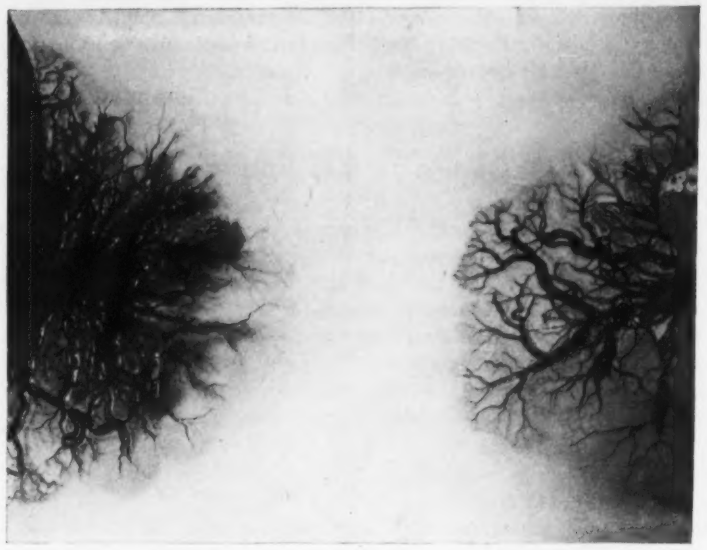
Wireless Telegraph on the Pacific.

A special dispatch from San Francisco says: "Apparatus for wireless telegraphy has been installed at Point Reyes, forty miles north of San Francisco, on the coast line, and on the southeast of Farallon Island, which works perfectly. Prof. Alexander G. McAdie, in charge of the local branch of the United States Weather Bureau, assisted by Alfred H. Triessen, the government wireless telegraph expert, installed the plant."

Curious Action of Static Charge.

We are indebted to Mr. Fred R. Cutcheon, superintendent of the electrical department of the St. Paul Gas Light Company, for the following item and the photograph which accompanied it:

I enclose herewith a photograph of a peculiar electrical phenomenon; it was taken from the inside surface of a hard rubber box upon which was mounted a choke coil, of 28 turns, this choke coil being located at the point where our 25,000-volt overhead line, 30 miles in length, passes into an underground cable. Ordinarily, the drop



CURIOUS ELECTRICAL EFFECT.

over this coil is only a fraction of a volt, and the photograph shows what an enormous resistance the coil must offer to heavy static charges. The actual distance between the terminals is 9 in. The white appearance of the rubber is due to a white sooty deposit; the black radiating lines are charred rubber, which is raised up in ridges about ⅛ in. high.

There was no evidence of any discharge between lines. This same phenomenon occurred on all of the six choke coils, and was observed to a less extent on coils of the same make at the generating end of the line. The photograph was taken by Mr. George B. Overton.

New Telephone Patents.

TELEPHONE REPEATER.

A modification of the telephone microphone repeater has recently appeared which attracts attention because of the particularly ingenious arrangement of its various component parts. As may be seen from Fig. 1, a single diaphragm serves for both telephone and microphone parts, while the coil, *I*, shown inclined to the horizontal also serves a double function, viz., as induction coil and as receiver coil. The transmitter button, *c*, contacts with the diaphragm through three small contact joints and thus it follows any motion of it. The diaphragm in turn receives its motion under the magnetic influence of the induction coil core, which has a permanent polarization under the influence of its primary coil and a varying magnetization under influence of the secondary coils, one of these being in each of the circuits to be interlinked. The letters, *X* and *Z*, indicate the two widely distant stations which are to communicate through the repeater, while *T R* is a supervisory station connected in the primary circuit. This repeater is the invention of Merritt Gally, of Brooklyn, N. Y.

RINGING FACILITIES.

With "two-wire" central energy switchboards of some kinds, the energization of a so-called cut-off relay serves to maintain the only connection between the subscriber's station and the switchboard jacks. The coil of this relay is bridged across the jack and it receives its actuating current from the central battery through the cord circuit. Now, when an attempt to ring the subscriber is made, as the ringing key serves the cord circuit and disrupts, therefore, the connection between the battery and relay, this latter falls back and opens the line, thus defeating the ringing, unless some special arrangement is made to prevent. One such arrangement is that recently patented by A. D. T. Libby, of Chicago, which provides an extra outside contact for his ringing key, from which a connection is made to the battery, a retardation coil being included in the circuit. This connection provides a constant battery supply during ringing, while the presence of the retardation coil renders the circuit impervious to the ringing current. Mr. Libby has assigned his patent to the Kellogg Switchboard & Supply Company.

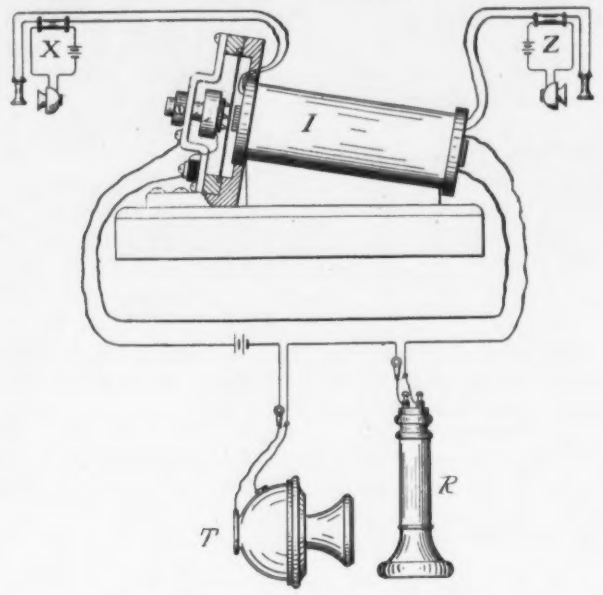


FIG. 1.—GALLY TELEPHONE REPEATER.

A second patent relating to ringing describes a new type of ringing key, which has been designed by W. Meyer, of Chicago. This key, which combines both ringing and "listening-in" is of the lever type, the most novel feature being the bending of the upper end of the contact springs on the "listening-in" side of the key in a manner such that when the lever is thrown, their pressure is normal to the lever pivot, and thus the lever remains in the thrown position in this direction without the use of auxiliary devices. The Stromberg-Carlson Company has obtained by assignment the patent for this key.

A SWINGING TELEPHONE SUPPORT.

Some years ago a few telephone companies produced a swiveled desk telephone, which, while supported at the side of a desk, could be swung over its top without the user being annoyed by the entanglement of the flexible cords with papers, etc., upon the desk. Recently almost none of these have been put into service, and, therefore, the telephone support, which has been patented by C. H. Pelton and W. Ramsey, of Springfield, Ohio, and which seems to provide

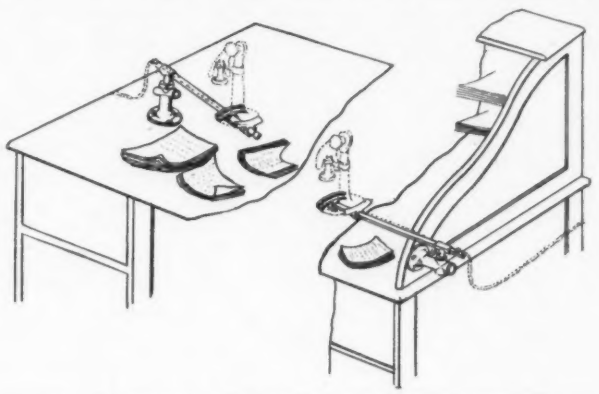


FIG. 2.—PELTON AND RAMSEY TELEPHONE SUPPORT.

all the features of the old swinging arms, should "fill a long-felt want." Fig. 2 shows the support applied to two desks and indicates the principles as well as could any further description.

TELEPHONE LOCK.

A new variety of telephone lock has been patented by S. J. Larned and J. S. Ford. This lock is to serve for the protection of the telephone company rather than for that of the subscriber, as it is to be used to lock a telephone from service in case of non-payment. A bolt or block is designed to fill the escutcheon above the switch hook,

being held in place by a hasp hinged thereto and threaded through the rings now customary upon the ends of the prongs of switchboards. The hasp is then secured by a padlock. The lock not only holds the hook in the depressed position, but prevents the removal of the receiver from the hook. The American Telephone & Telegraph Company have been assigned this patent.

REVERSE-CURRENT TRANSMITTER.

Phillip G. Randall, of Boston, is the patentee of a transmitter designed to cause actual reversals of current in the primary of its associated induction coil. The diaphragm is a stiff plate of carbon suspended in spring clamps engaging its periphery. The vibrating air impinging on the diaphragm causes its movement as a whole. Opposed to either face of the diaphragm are several microphone buttons mounted upon springs. All of these buttons upon one face are associated in one part of the circuit, while those upon the other face are associated in another group. These two groups of buttons are then so connected to the circuits and batteries and induction coil that the combined effect of the whole apparatus is an alternating indulatory primary current.

STEP-BY-STEP PARTY LINE SELECTORS.

Two selective party line systems, both depending for selection upon switches moved by steps under the influence of current impulses in an electromagnet are described in patents of last week's issue. Of these one requires three line conductors, while the other uses the ground in lieu of one of these for both the ringing and talking circuits. Messrs. F. A. Lunquist and J. K. Norstum are the patentees of this latter, while the former is the joint invention of Messrs. H. Redmon, R. L. Hall and R. H. Conway.

Marconi Wireless Telegraph Work.

Mr. John D. Oppe, general manager of the Marconi Wireless Telegraph Company of Canada, who is also a director of the American company, has been in New York recently. When asked about the operations of his company at Glace Bay, Mr. Oppe said: "While we are not yet in active commercial operation between Poldhu and Glace Bay, we frequently exchange signals and are in constant communication with the American station at South Wellfleet, a distance of over 800 miles of land and water. Mr. Marconi has been devoting his time to perfecting communication between Poldhu and Gibraltar, a matter of great importance to the British Admiralty, and has not been able to devote his attention to the American station as intended. A large demand upon his time arises from his contract to install the long-distance station at Pisa to communicate with the Argentine, 6,200 miles. Notwithstanding these two important projects he is expected to return to America soon, and I confidently expect that regular communication across the Atlantic will be established soon. The Canadian Government, it is understood, has in contemplation the establishment of a number of stations in the Gulf of St. Lawrence for the purpose of aiding navigation, including one at Sable Island, which is situated 100 miles from the main coast of Nova Scotia in the direct line of vessels sailing from St. John and Boston, and within easy communication of the route traversed by New York and Liverpool vessels. A station will also be erected in Nova Scotia to connect with that at Sable Island, and one may be established at Cape Race."

Mr. Oppe said that the reason another station might be needed on the Nova Scotia mainland was that the Sable Island station would be tuned differently to the one on Glace Bay, thus avoiding interference with one by the other.

Electric Power at the Charlestown Navy Yard.

A large plant to supply power to the various buildings and shops in the Charlestown Navy Yard at Boston is being installed. It will cost about $300,000 when completed. The equipment will include a 750-kw Westinghouse-Parsons steam turbine, direct-connected to an alternating-current generator. It is intended to add three more machines of the same size later on. Two 100-kw motor generators, for transforming the alternating to direct current are now being built and others will be installed. From this plant, besides the power for operating the machinery in the large shops, power is to be supplied for running machinery along the water front and also on board any ships that may tie up at the piers. The power for the ships will be conveyed through heavy flexible cables.

Work has been begun on the pump well for the new dry dock, which is to be made of glazed brick, and will be 43 ft. in diameter and 55 ft. deep. The two great pipes, shaped like Ys, and each weighing 26,000 pounds, which are to go on the bottom of the well, have been successfully cast and will be laid at once. The pump, which will have a capacity for discharging 65,000 gallons of water per minute, will be electrically driven. The motor which will run it will be of 500 hp and will be directly connected on the same shaft. The pump will be able to remove all of the water, about 14,000,000 gallons, from the basin in four hours, and will also be connected so as to empty the old dock.

Traction in Massachusetts.

The annual report of the Massachusetts Railroad Commissioners for 1903 shows that during the twelve-month periods covered the operations of both the steam and electric roads were the largest on record. A notable feature of the report is that the number of passengers carried by the steam roads is, for the first time in ten years, larger than the number carried in 1893, when the electric roads began active competition. The increase in the number of passengers carried by the steam roads during 1903 compares with that of the electric roads as follows:

PASSENGERS CARRIED

	Steam roads.	Electric roads.
1903	123,162,793	504,662,243
1902	115,645,897	465,472,382
Increase	7,516,896	39,189,861
Per cent increase	6.5	8.4

The number of passengers carried by the steam roads in 1903 compares with 119,779,947 carried in 1893, the previous high record, showing an increase of 3,382,846, or less than 2 per cent. The increase in the number carried by the electric roads in the same period was 294,110,234, or 136 per cent. The increase in passenger earnings during 1903 compares as follows:

PASSENGER EARNINGS.

	Steam roads.	Electric roads.
1903	$42,524,082	$27,027,651
1902	41,440,170	24,918,865
Increase	1,083,912	2,108,967
Per cent increase	2.6	8.4

The percentage of total net earnings to gross liabilities (capital stock, and funded and floating debt) compares as follows:

	Steam roads.	Electric roads.
Gross liabilities	$394,277,139	$133,121,411
Total net earnings	37,866,139	9,508,284
Per cent net to liabilities	9.5	7.1

A comparison of surplus available for dividends and capital stock compares as follows:

	Steam roads.	Electric roads.
Capital stock	$235,834,466	$68,404,480
Surplus after charges	13,748,969	3,602,916
Per cent surplus to stock	5.8	5.3

Trolley for Calais, France.

The quaint old French town of Calais is to have trolleys. U. S. Consul Milner writes: "Calais still has horse tramways, operated by an English company that has a franchise to run for seventeen years. The municipality projected an electric tramway system and was granted the concession by the French Government. The contemplated system is estimated to cost $600,000, in which three lines were comprised, having a length of 16 miles—8 miles within the corporate limits of the city—the contemplated system of traction being the Dickinson trolley. It was intended to commence the construction next spring and have the same in operation within one year. These plans have been upset by the death of the contractor, whose heirs are now trying to sell his rights. This leaves an opening for some company to become his successor by arranging with his heirs. An opportunity may exist here for some enterprising American company."

Annual Meeting of the Northwestern Electrical Association.

(*By Special Telegram.*)

The twelfth annual meeting of the Northwestern Electrical Association was called to order in the club room of the Pfister Hotel, Milwaukee, Wis., Wednesday, January 20, with the president, F. W. Bowen, in the chair. A satisfactory report from the secretary and treasurer, Mr. Mercein, was read and adopted. The president's address was devoted to the subject of making the programme of the association at its meetings of the greatest value to the members, and it also considered several phases of central station business in relation to the public and the prosperity of the operating companies. It was heard with much attention and interest. The meeting adjourned until 1.45 P.M.

The Nomination Committee appointed by the chair consisted of R. N. Kimball, of Kenosha, Wis.; H. W. Frund, of Vincennes, Ind., and P. H. Korst, of Janesville, Wis.

The Membership Committee was constituted as follows: J. H. Harding, of Laporte, Ind.; W. H. Schott, Chicago, Ill.; Irving P. Lord, Waupaca, Wis.

The Committee on Uniformity of Advertising Matter reported and was continued, Mr. Harrow Almert being added.

The report of the Legislative Committee, although one which should be of much interest and importance, was not received.

The first paper read was that on "Central Station Heating," by W. H. Schott. It evoked a very spirited discussion regarding the operating features of heating plants in connection with central station work. The next paper read was an interesting one on "Coil Winding for Electrical Purposes," by Messrs. Richard Varley and Charles R. Underhill, the latter of whom presented it. There was no discussion. This paper treated on the rather undeveloped subject of the accurate design of electromagnets for general use and showed that the best method of obtaining data regarding the general behavior of electromagnets is to construct actual magnets, solenoids, etc., and obtain the data by making actual tests. As the magnetizing force necessary to operate any magnet is proportional to the ampere-turns in the winding, the ampere-turns once having been found, it is comparatively easy to design any winding for different voltages. If the current is to be left continually on the winding, the winding will heat considerably; therefore, in order to design a winding which will give the best result with minimum heating, it is also necessary to make actual tests from the various magnets to determine just how much heat they will radiate under various conditions. The economy of the winding was also referred to, and the relation between the actual winding space occupied by copper and by the insulation compared. Some formulæ were also given from which tables of constants have been made whereby the windings may quickly and easily be calculated. Stress was laid on the importance of detail, which shows that it is necessary to have accurate data in order to make the practical results check with the theoretical.

The next paper presented was that of Mr. W. Scheidel, on "Rectifiers." This was read by the secretary, and there was no discussion on the subject. An interesting paper was presented by Mr. John C. Keech on incandescent lamps in general, and their smashing point in particular. The address pointed out the universal adoption of the idea that 80 per cent. of the initial candle-power was the point at which the limit was reached of the useful life of a lamp. The lamp should be smashed when the cost of maintenance was greater than the actual profit from keeping the same up. Users, however, do not carry out the idea, which results in the company furnishing the current being condemned. There was no question of the fact that periodical renewals at the right moment were profitable, and he described improvements in make which aimed at and resulted in lamps burning out automatically at the smashing point. There was a lengthy discussion regarding the proper use of the lamps, in which many useful and interesting points were brought out by hard-headed practical members. The convention then adjourned until 10 o'clock on Thursday morning.

In the evening there was a theatre party given, to see the "Fortune Teller," at the Alhambra Theatre. On Thursday morning the session was arranged to begin with Mr. J. H. Waring's paper on "Storage Batteries for Central Station Work." The other papers will be carried out as per programme, already printed.

Mr. W. Sheidel, of Chicago, read a paper entitled, "The Electrolytic Rectifier and Interrupter," in which he described the Churcher alternating-current rectifier. It is stated that this device rectifies both waves of alternating current and consists merely of one jar, one solution and one set of electrodes. A transformer is required with a secondary of twice the direct-current voltage required plus the resistance loss; the secondary coil is tapped in the center, this tap remaining always positive. The rectifying cell is of the aluminum type and the active electrodes are attached to the secondary terminals of the transformer, the number depending upon the phase of the alternating current supplied. Between the active electrodes, but insulated from them, is placed an inactive electrode, preferably of platinum. Connected between this electrode and the center tap of the transformer is the battery to be charged, the direct-current motor or other apparatus to be operated.

In operation the current passes from the center tap of the transformer to the motor, from the motor to the inactive electrode in the rectifying solution; thence through the solution to one or the other active electrode, depending on which at that instant is negative to the center of the transformer. Inside the rectifier the current passes from the inactive electrode first to one then to the other active electrode, as the alternations of the cycle take place, the center of the transformer remaining positive at all times. It will thus be seen that one side of the transformer is active while the other is inactive during one alternation, and vice versa. The regulation of the direct current is best attained by placing an adjustable inductance between the transformer terminals and the active electrodes of the rectifier. The limit of the voltage of one cell of the Churcher rectifier is stated to be about 70 volts direct current. Through the use of two cells and two secondaries in one transformer, twice the voltage can be obtained, and by increasing the number of cells and the secondaries still further, higher voltages may be obtained.

The paper also refers to the interrupter invented by Mr. Churcher, which will work with any potential or frequency of alternating current and deliver a rapidly and completely interrupted direct current through the primary of an induction coil. The construction and method of operation is similar to the Churcher rectifier, the only difference being in the area of exposed contact of the positive electrode, which is so restricted that instantaneous interruption of current is obtained by the well-known Wehnelt effect.

In spite of the inclement weather experienced in the West, the attendance was good, and the association is to be congratulated, as before, on the practical character of its work.

Further Gift for the Union Engineering Building.

The committee of fifteen, representing the four national engineering societies and the Engineers' Club, on the gift by Mr. Carnegie of $1,000,000, have been doing a great deal of hard work, and this week it became known that notable progress could be reported by them. The plans prepared for the Union Engineering Building and for an entirely separate club house have brought out the fact that, with their large growing memberships this munificent sum would hardly cover all the wants of the various bodies, especially if the Civil Engineers should finally decide to come into the scheme. On Monday last this was brought to Mr. Carnegie's attention, when, with characteristic generosity and promptitude, he added immediately in writing to his previous famous letter, the statement that to make adequate provision for the Civils he would add another $500,000. He also provided at the same time for further purchases of property for the site.

The American Society of Civil Engineers held its annual meeting in New York City this week at the Carnegie Lyceum and then voted to send out a circular of pros and cons on the project and to take a letter ballot returnable in March as to whether the Civils should or should not join the sister societies. There was a great deal of animated argument at the meeting on the subject, some of the older members having apparently very strong views against accepting the gift or against joining hands with the other bodies. The action of the Civils in regard to the acceptance by them of the gift will be watched with great interest.

Bell Telephone Laundries.

An unusual state of affairs exists at Mansfield, Ohio. Spurred by the action of the laundry proprietors, plumbers and the gas fitters, who have pledged their support to the independent local telephone company, the Bell Telephone Company has rented stores and will engage in these businesses.

CURRENT NEWS AND NOTES.

GERMAN LAMPS.—A firm located at Cologne has just received an order from the City Council at Edinburgh, Scotland, for 10,000 incandescent lamps. It is reported that 34 firms submitted bids upon this order.

THE INDIANAPOLIS ENGINEERING SOCIETY has been organized at Indianapolis, Ind., to include in its membership civil, mechanical and electrical engineers and architects. The society starts with fifty members. Charles C. Brown is president and W. E. Buehler, secretary.

DEATH OF DR. HEFNER-ALTENECK.—Dr. Friedrich von Hefner-Alteneck, the distinguished German electrical engineer, died of apoplexy on January 7, at the age of 58 years. In 1872 he invented the drum armature for dynamos. He also invented one of the first differential arc lamps; a transmission dynamometer, and, in 1883, the "Hefner" amyl-acetate standard of light.

AN "OLD VINTAGE."—Mr. W. L. Frazee, superintendent of the government electric light plant and the police and fire alarm telegraphs at Honolulu, Hawaii, in a recent letter to this country says: "This plant is about the same as when first installed—no improvements whatever since 1886—using the same old transformers made by the Thomson-Houston Company. It has always been my desire to remodel it with the latest improved apparatus. I think it would make an interesting exhibit at the St. Louis Fair."

MAGNET STEEL.—In a paper read by Mr. N. Lilienberg before the Philadelphia Foundrymen's Association it is stated that it is possible to produce by superheated side-blown process steel uniformly lower in carbon and manganese than by any open-hearth or bottom-blown process. Many tests have shown by this process it is possible to increase the magnetic qualities of steel by 10 per cent. M. Tropenas has stated, and the claims have been corroborated by others, that the permeability and hysteresis curves of such steel approach those of Swedish iron.

SECRETARYSHIP OF AMERICAN ELECTROCHEMICAL SOCIETY.—As recently reported in these columns, Mr. C. J. Reed has announced that owing to pressure of professional work he cannot accept re-election to the office of secretary of the American Electrochemical Society. Among the names brought forward as candidates for the position are Dr. J. S. Richards, now president of the society; Dr. S. S. Sadtler and Dr. E. F. Roeber. Owing to the growing work of the secretaryship it is probable that a salary will be attached to the position hereafter.

TROLLEY IN SWEDEN.—Mr. E. L. Adams, United States Consul-General at Stockholm, Sweden, writes: "Stockholm's electric tramways now in construction are to be ready for use early next year. The tenders accepted for the new "nes were made by Swedish and German contractors in combination. The American bidders were unsuccessful in securing the contracts. The amount to be expended in this work is about 3,000,000 kroner ($795,000). Several other cities in Sweden—Gefle, Malmo, Norrköping, Sundsvall and others—are contemplating exchanging their street railway lines from horse power to electric power."

ICE DAMAGES A NIAGARA POWER HOUSE.—A mass of ice in the form of a huge icicle which collected on the side of the bluff overhanging the power house of the Niagara Falls Hydraulic Power & Manufacturing Company, at Niagara Falls, became detached from its support and crashed through the roof of the power house, on Tuesday of this week. Press dispatches state that two roof girders were broken and a hole 60 ft. wide made in the roof. The ice and debris fell upon the machinery in the generating room, temporarily disabling some of the machines. The station was shut down for a short time to avoid short-circuits from the ice and water, but afterwards resumed operations.

A. I. E. E. JANUARY MEETING.—The January meeting of the American Institute of Electrical Engineers will be held at the Chemists' Club, 108 West Fifty-fifth Street, New York, on Friday evening, January 29, at 8.15 P.M. The following papers will be presented at this meeting: "The Alternating-Current Railway Motor," by Charles Proteus Steinmetz; "Speed-Torque Characteristics of the Single-Phase Repulsion Motor," by Walter I. Slichter. These two papers relate to the latest and most interesting advance in electrical engineering as applied to traction purposes. Mr. Steinmetz's paper deals with the subject from a simple mathematical point of view, and Mr. Slichter's paper from a more general point of view. It is expected that these two papers will provoke an exceptionally interesting discussion.

ELECTRICITY AT EXPOSITIONS.—Prof. W. E. Goldsborough, chief of the Department of Electricity, World's Fair, St. Louis, Mo., will lecture on "The Influence of Electricity upon Expositions" before the New York Electrical Society on January 27, at 19 West Forty-fourth Street. He will discuss the use of electricity in connection with exposition work since the introduction of electric power, starting with the very earliest and most primitive applications. The evolution which has taken place in the making of exhibit installations will be brought out, leading up, as it will, to an estimate of the installations which will be made in the Electricity Building at St. Louis. A general view of the electric decorative effects in connection with the interior and exterior illumination of exposition buildings will also be given. The lecture will be profusely illustrated by lantern slides. Ladies are specially invited, and aside from the general popular interest of the subject should enjoy the beautiful pictures presented.

SIGNALS UNDER WATER.—A special telegram from Boston of January 24 says: "Tests of the Gray system of submarine signalling were made to-day on board the steamship *James S. Whitney* during her trip from New York to this port. Submarine communication by bell signal was established with three lightships while the steamer was some distance from them, apparently showing that the system may be useful in averting collisions. On board the *Whitney* were representatives of the Canadian Government, who made the trip to test the efficiency of the system. By permission of the United States Government, four lightships on the course had been equipped with submarine bells, which were to be tolled automatically. The *Whitney* left New York at midnight last night, and at 2 o'clock this afternoon as the ship approached the Pollock Rip Lightship the distinct sound of a tolling bell was heard in the receiver in the pilot house. A few minutes later another bell was heard which, the officers said, was submerged at the Pollock Rip Shoals Lightship. At 7.20 o'clock to-night, as the *Whitney* neared Boston Harbor, the sound of a bell was heard clearly in the receiver, and the captain altered his course at intervals so that the sound of the bell was heard both from the port and starboard sides."

TURBINE ELECTRIC GENERATOR.—Some weeks ago we noticed a patent issued to Messrs. E. H. Porter and Burleigh Currier on a novel steam turbine generating set, and last week another patent was issued to the same inventors on another type of combined steam turbine and generator. On the peripheries of the turbine blades are carried toothed inductors similar to those used in the well-known types of inductor alternators. These, when driven by the turbine blades, act in multiple to vary the inductance between two stationary windings, one separately excited and acting inductively on the other, the generating winding. Bar windings are threaded through porcelain tubes laid through the magnetic circuit of laminated plate construction. In this machine the energy is thus transmitted direct from the turbine blades electrically. The ordinary iron and copper losses are increased above what is usually considered good practice in dynamo design so as to have the turbine blades heated to a temperature slightly in excess of that of the steam to prevent condensation on the blades, this superheating process thus enabling the heat of the so-called generator losses to be absorbed by the steam in its passage through the turbine. The generator shown in this patent differs from the previous one in being a combined turbine and a synchronous, separately-excited type of alternator, the first-mentioned having the turbine combined with the synchronous induction generator best adapted to operate in multiple with other generators of the synchronous type. The shaft of the turbine does not extend out of the case, the transmission being entirely electrical and the ends of the bearings are closed to prevent the escape of steam.

WIRELESS TELEGRAPHY IN PORTO RICO.—The wireless telegraph stations at San Juan and Culebra, Porto Rico, have, according to a dispatch from San Juan, been opened, and are working satisfactorily.

TO THE FRONT.—It is stated that the Japanese Government has ordered back to Japan twelve of the fifteen Japanese engineers who are at the Westinghouse Electric Company's plant at East Pittsburg, on account of the threatened war.

LIGHT FOR VENICE.—Mr. R. W. Bliss, United States Consul at Vienna, reports that for two years past a company has been steadily working to harness the water power of the River Celina electrically and promises to turn on current by January next. He thinks this will make an opening for many electrical appliances of American type and origin.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—Secretary Davis, of the National Electric Light Association, visited New York last week to look after association affairs. He reports that the association is in a very flourishing condition. The programme for the 27th convention is being rapidly formulated, and will contain many novel features. The Question Box, in the able hands of Mr. H. T. Hartman, is already pretty well filled up with queries, but there is room for as many more as members wish to ask, and it is hoped that they will avail themselves freely of this means of gaining useful information.

ELECTRICITY AT TRIESTE.—Mr. F. W. Hossfeld, United States Consul at Trieste, reports a large plan on foot for the extension of the dockage and warehouse facilities at Trieste, all the cranes, hoists, capstans and other machinery of which will be driven by electrical power. He also states that the commission which the Austrian Minister of Railways sent recently to Milan to investigate and report on the electric railways of Lombardy, has recommended the adoption of electric traction for the new lines of railway of which Trieste will be the terminus. In the event of carrying out this recommendation, the new railways will be supplied with electric currents from the same power plant as the harbor.

TELEPHONY IN CALIFORNIA.—The city of Bakersfield, in proportion to its population, has, according to the report of the manager of the Sunset Telephone Company, more telephones in use than in any other city in California. It has 1,550 telephones in operation, and, based on the census of 1900, this means something over 36 to every 100 inhabitants. On the same basis Santa Cruz has less than 13 to the hundred, San Diego 12, Oakland 11, Los Angeles 12, San Francisco 12, Sacramento 11, Redlands 12, Napa 10, Hanford 28, Chico 23, Visalia 21, Fresno 21, Eureka 20, Pasadena 20, Salinas 17. All of these proportions are high. The Bakersfield ratio would give about 25,000,000 telephones for the United States, instead of the present 5,000,000.

NEW TUBE FOR LONDON.—A cable dispatch of January 16 says: "Another twopenny tube is to be thrown open to the public on February 1. This is the Great Northern & City Railway, between Finsbury Park and Moorgate Street, which is so near completion that a party has been taken over the whole route in a model train for a tour of inspection. The road is nearly four miles long and brings a very populous district in touch with the city. This tube is a distinct advance on the similar railways already working in London. Some of those who made the trip pronounced it the best underground railway so far constructed in the world. The tunnels have a 16-ft. diameter, as compared with the 11 ft. 8 in. of the Central London Railway, and this permits the use of larger rolling stock. The cars are somewhat longer than those in use on other tubes. They are built of teak, with a height of over 12 ft., which makes them roomy and airy. They are, in fact, of equal width with the widest carriage that can be run on any British railway, the bulging sides making for greater comfort. All the seats are crosswise, with a center aisle. There are doors in the center of the cars for emptying and filling with great celerity at the terminals. The stations along the route are roomy, with big lifts and wide staircases. All the structures underground, including even the signalmen's cabins, are fire-proof. The trains are made up of seven coaches, three of which are motor carriages. One of these is placed in the middle of the train. 'An all-British twopenny tube!' cries the *St. James Gazette,* describing the railway. The Brush Electrical Engineering Company built many of the carriages at its English works. They are supplied with Westinghouse air brakes and the motors were built by the General Electric Company, while the driving system is the Sprague multiple unit."

LETTERS TO THE EDITORS.

Resistances in Transformer Circuits.

To the Editors of Electrical World and Engineer:

SIRS:—On August 8, 1903, you published my article on "The Effect of Series Resistance in the Transformer Circuit." I learned just a few days ago that the *Elektrotechnische Zeitschrift* brought out in its issue of September 10, 1903, page 753, an abstract of that article, pointing it out as an interesting one. Later, in their issue of October 8, 1903, page 854, Mr. Gustav Benischke discussed the article fully under the heading "Letters to the Editor," and his conclusion is that my statements are wrong. Furthermore, in their issue of November 12, page 949, Mr. Hugo Grob wrote that Mr. Benischke made a ridiculous failure in the objections brought up against my paper, because its exactness is evident not only by the theory, but by the results of the experiments given in the paper.

I would beg to suggest the propriety of the *Electrotechnische Zeitschrift* communicating with ELECTRICAL WORLD AND ENGINEER under such circumstances, so that the author may either explain or defend his standpoint under such circumstances.

PITTSFIELD, MASS. HENRY PIKLER.

[It is not customary for editors to adopt the practice suggested by Mr. Pikler.—EDS.]

Reduction of Fire Losses by Proper Inspection.

To the Editors of Electrical World and Engineer:

SIRS:—The recent disaster at the Iroquois Theatre in Chicago carries grave lessons home to every thoughtful resident of our large cities. It is appalling to realize that the latest and most scientific methods of construction do not of themselves always insure safety, and this horrible catastrophe is a tragic commentary on the imperfections of human knowledge. We are too inclined in these days of wonderful material progress to take it for granted that the great forces of nature are so well tamed that they need little watching when applied to the service of man.

Of all the natural elements, fire is perhaps the best friend and the bitterest enemy of the human race. The annual losses in life and property from this source reach a tremendous total. Gradually the world is awakening to the importance of devoting its best thought to fire protection and prevention, and in the last few years a new profession has come to the front with this in view—Fire Insurance Engineering.

Whatever the final cause of the Chicago calamity may have been, the one tremendous lesson of the hour is the vital importance of expert inspection in every building where heat, light and electricity are utilized. The careless handling of such forces by dishonest contractors and ignorant, underpaid employees is simply a free invitation to a tragedy—it is insanity flying in the face of Providence.

Accidents like the breaking of a steel rail or a steamship shaft are at times unavoidable, and cannot always be foreseen. They are a part of the price which we pay to nature for making use of her exhaustless power and wealth. Little, if any, excuse exists, however, for fire in a modern building properly constructed and inspected. The fire underwriter should know this if the public does not, and upon him rests an immediate responsibility—he must bend every effort to secure expert inspection of each structure which he insures, and not one cent of insurance should be placed until the building is pronounced safe by an experienced fire insurance engineer. Let the underwriter take this decided stand, insisting on safe construction throughout, and the public will soon demand the same thing on its own account. Nor should the precautions end here. Frequent inspection should be made of every building where forces capable of causing fires are in operation, especially in buildings where large numbers of people congregate. Thus, no scenic application of elec-

tricity should ever be permitted in a theatre until the arrangement of the apparatus and wiring satisfies the fire insurance engineers' most rigid requirements of safety.

Already two laboratories for the study of fire prevention are in operation in this country. One of these is connected with the Massachusetts Institute of Technology, in Boston, and the other is located in Chicago, both being supported by powerful insurance interests. In order to provide the systematic inspection required, however, many trained men are needed. This will cost a large amount of money each year, but the reduction in fire losses ought to more than offset the expense. Surely, the saving of many human lives each year is a sufficient object in itself.

It is time for the philanthropist and the underwriter to invest capital in proper inspection. It is time for the technical school and college to add to its curriculum a course in fire insurance engineering. It is time that some of the young men who are facing the overcrowded condition of the older professions should make fire prevention their life work, and it is time that the great public realized the importance of systematic and scientific efforts to rid the world of fire losses.

DENVER, COLO. HOWARD S. KNOWLTON.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Commutation.—PICHELMAYER.—An illustrated paper read before the Electrical Society of Vienna. He discusses the electric causes of sparking at the commutator. If an ordinary direct-current dynamo, the brushes of which may spark somewhat, is run at a gradually decreasing speed, while the current output and the excitation remain constant, it is found that the sparking becomes less and less and disappears entirely at very low speed. In this case, if we consider the local circuit in which commutation takes place and which contains the brush, the two commutator segments touched by the brush, their connections with the armature, and the short-circuited armature coil, then the only e.m.f's to be taken into account at very low speed in this circuit are those consumed by ohmic resistance, while at higher speeds two other kinds of e.m.f's come into play, namely, the e.m.f. of self-induction and the e.m.f. induced from the external field, which is generally small at this point. As long as the speed is low and only the volts lost by ohmic resistance are to be considered, the current distribution may be easily found by Kirchhoff's rules. The author shows that in this case, if the current flowing in the short-circuited coil is plotted in a diagram as a function of the time, it is represented by a nearly straight line, as long as carbon brushes are used and the transition resistance from the brush to the commutator is at least twice as great as the ohmic resistance of the short-circuited coil and its connections with the commutator segments. The greater the transition resistance, the more will the time curve of the current of the short-circuited coil approach a straight line. He calls the condition under which the curve is a straight line, the "pure resistance commutation," and considers this condition as the ideal case, since the current density at any point of the brush is then constant during the whole period of commutation, so that no sparks can occur, the produced heat being a minimum. The problem is now to produce the same condition at higher speeds. Since here the e.m.f. of self-induction and the e.m.f. induced from the external field are to be taken into account, the problem is to arrange matters so that the latter two e.m.f's are exactly equal and opposite. The result will then be that we have again the condition of pure resistance commutation. If the curve mentioned before representing the current in the short-circuit coil as function of the time is a straight line, then the e.m.f. of self-induction will be constant during the whole period of commutation and the problem is to make the e.m.f. induced from the external field also constant and exactly equal to the e.m.f. of self-induction. The well-known means by which sparking has been counteracted for many years is to advance the brushes from the neutral zone; in the light of the author's theory, the object is to bring the short-circuit commutating coil into a somewhat stronger field, so that the e.m.f. induced from this external field will counterbalance the e.m.f. of self-induction. The author points out that all designers have arranged to have the field at the point where they place the brush nearly constant or at least increasing only slightly. For special machines which run at very high speed, like those coupled to steam turbines, this remedy is, of course, not sufficient, and it is then necessary to provide a special "commutating field" at the place where the commutation takes place, and of such a size that the e.m.f. induced by it in the short-circuited coil exactly counterbalances the e.m.f. of self-induction induced in the same. This may be done by means of special commutation poles, as shown in Fig. 1 for a bipolar machine. They are supplied with the armature current, and by a suitable design it is easy to insure that the commutation field is constant over the whole commutation zone. For calculating the e.m.f. of self-induction the author recommends the

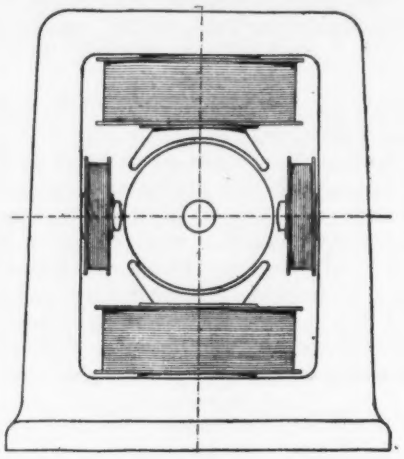


FIG. 1.

formula of Parshall and Hobart. and one of the main results of his paper is that the so-called reactance voltage (which, according to older theories, should be below a certain limit) may assume any value whatever as long as a commutating field of such a size is provided that it counterbalances the reactance voltage. In the discussion which followed, Deri remarked that the theory of the author exactly corresponds with what he has done for years in his direct-current dynamos in which he annuls the armature reaction and also provides a commutating field for counteracting the reactance voltage in the short-circuited coil. He states that many machines of his system are in practical use, and that direct-current dynamos driven by steam turbines, and running at 4,000 r.p.m., with a capacity of 1,500 kw, have proven practically successful. He also mentioned experiments in which he found that by means of the improved commutation device, it is possible to produce in shunt machines with ordinary commutator much higher voltages than heretofore. On account of the annulment of all obnoxious and dangerous e.m.f's produced during commutation, it is possible to increase the voltage between commutator segments far beyond those values which were heretofore considered as a limit. Orgler gave some details of the successful operation of compensated Deri machines in connection with the Orgler system of hoisting. Pichelmayer replied that he did not want to minimize the merit of Deri, but it is important to know that the accomplishment of Deri can also be obtained in other ways if only the general principles explained in his theory are followed. Reference was also made to a device of Seidener, who uses an auxiliary armature, running between the main armature and the commutator within the poles of a special magnetic field. The connections between main armature and commutator form the windings of the auxiliary armature. Seidener stated that Edison had patented a similar arrangement in 1887.—*Zeit. f. Elek.* (Vienna), January 3. A shorter account of the principles given in

Pichelmayer's paper is given in an article in *Elek. Zeit.*, December 31.

Determining the Lengths of the Poles of Field Magnets.—COOKE.—A communication in which he gives a formula for determining the lengths of the poles of field magnets by a more direct method than is at present adopted. Since the length of the pole depends entirely on the length of the bobbin to be put on it, the method now used is to assume a trial value, then make a drawing of the machine, and from this calculate the mean magnetic paths, from which are deduced the total number of ampere-turns required per pole. Assuming a suitable magnetizing current, it is now possible to find the number of turns and hence to design the bobbin. This gives a new and final value for the pole length which necessitates a new drawing, and alters the mean magnetic path in the pole cores and yoke. The schedule has now to be altered and the current changed to suit the new number of ampere-turns. The formula given by the author states that the length of one layer of wire equals a numerical constant multiplied by the product of magnetizing current and number of turns of wire per bobbin, divided by the product of depth of wire on the bobbin and current density in the wire. The numerical value varies between 2 and 1.5, being 2 for a magnetizing current of 1 amp. and 1.5 for a current of 10 amp. for a current density of 700 amp. per sq. in. The method of using this formula is as follows: Make a drawing of the armature as before, and from it calculate the number of ampere-turns required for the gap, teeth and armature body. This gives the product of magnetizing current and number of turns of wire per bobbin, required for the formula. The depth to which the wire may be wound is governed by the permissible heating, and depends, therefore, on the specifications. The length of the bobbin can thus be found; to this must be added the thickness of the two bobbin ends and the insulation between the wire and the bobbin to obtain the true length of the pole. The field magnets are then added to the drawing of the armature.—Lond. *Elec.*, January 1.

REFERENCE.

Repulsion Motor.—BLONDEL.—Continuations of his long illustrated serial on single-phase commutator motors. In the present installments he deals with the theory of the repulsion motor. In view of the highly mathematical character of the paper, an abstract is impracticable.—*L'Eclairage Elec.*, December 12, 19.

LIGHTS AND LIGHTING.

Efficiency and Temperature of Nernst Lamp.—INGERSOLL.—An account of a determination of the efficiency of the Nernst lamp by the method of Angström, in which the total spectrum of the light is dispersed in order to screen off all but the visible spectrum and the visible rays are then recombined into white light by means of a cylindrical lens and balanced photometrically against the total radiation from another exactly similar source. The energy of the two radiations can then be compared by replacing the photometer screen with a bolometer or thermopile. The filaments were burned freely in the air, without heaters, on a 100-volt alternating-current circuit. He found that Nernst filaments are by no means uniform, since new filaments show an efficiency of from 4.35 to 4.70 per cent., while the efficiency falls rapidly for about the first 20 hours, decreasing to a mean of 4.3 per cent. and varying only slowly after this. Tests of filaments of 40 hours and upwards give a mean efficiency of 4.17 per cent. Some very old glowers gave only 3.6 per cent. After a glower has been burned upwards of 20 hours it obtains a marked crystalline appearance, and it is probable that a fall in efficiency is due to a greater radiating surface and consequent lower temperature afforded by the crystalline structure. If, as is now proposed by the Westinghouse Company, the glowers are aged before they are sent out, the deterioration with time may no longer be observable. The energy curve plotted from Wien's law, which gives the efficiency 4.17 per cent., i. e., which gives the ratio of visible energy to total energy = 0.0417, is that corresponding to the temperature 2360° C. This, then, would be the temperature of the Nernst glower, considering it as a "black body" in the sense of thermodynamics. This value lies well within the limits 2200° and 2450° C., given by Lummer and Pringsheim.—*Phys. Rev.*, November.

Distribution of Light from Incandescent Lamps.—WILD.—An article in which the author gives a table comprising the results of measurements of the candle-power of eight lamps in all directions, with diagrams of the filaments of these eight lamps. This table shows that the candle-power measured normal to the mean plane of the filament (called by him the normal candle-power) can generally be accepted as a measure of the mean spherical candle-power of the lamp. In practice the light emitted in any direction is not strictly proportional to the apparent surface of filament presented to that direction; the cause of this discrepancy is that the glass bulb does not transmit all the light rays that fall upon its surface, but reflects back a portion. The surface being curved and the filament not being equidistant from all parts of the bulb, the reflected light is to a certain extent concentrated into particular directions. When the direction in which the best illumination is required is not specified, lamps should be tested for mean spherical candle-power. As, however, this measurement is somewhat tedious, many substitute for it the measurement of the mean horizontal candle-power of the lamps to be tested. The mean horizontal candle-power is, however, very far from being proportional to the mean spherical candle-power. A far better plan is to measure the normal candle-power (as defined above). Speaking generally it appears from the table that when the mean horizontal candle-power is high, the vertical candle-power is low and vice versa, but no distinct law can be traced. For the general illumination of a room, a lamp should be chosen giving high candle-powers horizontally and at 30° below the horizontal. When a lamp is required to illuminate a small area, such as an office table, a filament should be chosen giving as large light as possible vertically downwards and also at 60° below the horizontal.—Lond. *Elec. Rev.*, January 1.

POWER.

Development of Small Water Powers.—BELL.—An article on the development and utilization of water powers having a capacity of less than 500 hp. The author assumes a stream having a reliable flow of 100 cu. ft. per second during the dry months and a working head of 25 ft., the maximum flow being 400 cu. ft. The assumed average minimum flow would yield just about 225 hp if utilized with a first-class turbine, and the electrical product of this power—a little over 150 kw—could be sold twenty-four hours per day, save for a few days at a time in very dry years. For nine months of the year twice this output could be delivered. Since an electric light plant would be the best customer for this power, the author considers how far storage can be brought into play to build up an output big enough to be of some use. With a normal minimum flow of 6,000 cu. ft. per minute the working power for a 12-hour run can be developed by storing a little over 4,000,000 cu. ft. of water. This would mean drawing down a 100-acre pond one foot at night and letting it fill up when the load is substantially off during the day. In a very dry year there may be a further deficit of flow amounting to a little over 2,000,000 cu. ft. in every twenty-four hours, so that the storage pond can be planned for if feasible. The development of the power does not require a large outlay. A well-ballasted timber crib is recommended for the dam. A small penstock is recommended. The number of hydraulic units should be so chosen that the temporary crippling of one will not cause serious inconvenience. The total capacity should be put, say, in four 150-kw machines. Any more than this would probably lead to increased expense, and any less might cause too severe an overload in case one machine shut down. Regarding the electrical system to be employed, if the power was to be developed for lighting the system is not of much consequence, direct current answering this purpose; if the power is to be transmitted a moderate distance, and loose pulleys are used on all but the smallest motors, a straight single-phase system answers, but where the power is transmitted a long distance and the actual distribution is carried from a sub-station a 10,000-volt transmission line is recommended. All the requisites for a first-class transmission line are considered. A possible supplementary steam plant is discussed in connection with the sub-station.—*Am. Elec.*, December.

Italian Hydraulic Power Station.—A note on the water power station which has recently been completed at the foot of Mont Cenis for power transmission to Turin, forty miles distant. The head of water is no less than 2,830 ft. and the quantity of water is 35.3 cu. ft. per second; 11,500 hp are thus produced, and by regulating the flow of water by means of a dam, 16,000 hp may be obtained if necessary. In order to avoid excessive pressure in the pipes, the head is utilized in two stages and at present only the lowest stage is completed. Three generating sets, each consisting of a turbine directly coupled to a 1,400-kw alternator, are installed at present, one set acting as reserve. The head of water of this lowest stage is 1,380 ft. and the turbines rotate at a speed of 500

r.p.m. The alternators, which weigh 33 tons each, generate current at 3,000 volts with a full-load efficiency of 96.5 per cent. The exciting current is furnished by a 110-hp turbo-generator set. Water-cooled transformers raise the voltage to 30,000 volts for transmission to Turin.—Lond. *Elec.*, January 1.

Traction.

Alternating-Current Traction.—Bell.—An article in which the writer calls attention to the almost simultaneous production in three different countries of a single-phase railway motor along somewhat parallel lines, although they differ in details. He states the objection to polyphase induction motors and some of the difficulties heretofore encountered in constructing a single-phase motor. Referring to the Lamme or Westinghouse motor, he says that the performance of this new motor is quite comparable with that of standard direct-current motors, and although it is somewhat heavier does the same work and apparently does it well. At starting the power factor is low, but during a two-mile run it is approximately 87 per cent., and at full speed above 95 per cent. He then refers to the Eichberg-Winter motor, which belongs to somewhat the same class as the Lamme motor, but is not an ordinary series motor, being more akin to the Thomson repulsion type of alternating-current motor. The Finzi motor is also referred to.—*St. R'y Jour.*, December 19.

Interurban Road in Switzerland.—Somach.—A fully-illustrated description of the electric road between Wetzikon and Meilen, of 22.5 kw. length in the Zuricher Oberland. The trolley system is used, with the rails for the return, the voltage being 750. Each car is provided with four 22-hp, 375-volt motors, divided into two groups, each containing two motors in series. The power is supplied from the Beznau water power plant in the form of 25,000-volt, 50-period, three-phase current. Three 160-kw transformers reduce the voltage to 460, while two 140-kw rotary converters change the current to direct at 750 volts.—*Le Génie Civil*, December 26.

Electrification of British Railway.—An article on the electric equipment of the Lancashire & Yorkshire Railway, which decided about a year ago to electrify about 23 miles of double track. Operation will be started early this year. The trains will be composed of two first and two third-class cars, the third-class cars being equipped with four motors of 150 hp each. Direct current is supplied from a third rail at 600 volts. The power station contains five steam-driven generating sets, four of 1,500 kw and one of 750 kw, three-phase currents at 7,500 volts with a frequency of 25 periods being generated. Three-core paper-insulated metallic-sheathed cables laid "solid" convey the high-tension, three-phase currents to four sub-stations. The sub-station equipments, similar in character, consist in twelve air-cooled transformers and four 600-kw synchronous converters.—Lond. *Elec.*, January 1.

Traction Plant.—Fumero.—A fully-illustrated description of the Morbegno station, which supplies current to the Valtallina Railway in Northern Italy. Three-phase currents are generated at 20,000 volts and distributed to transformer stations along the line, in which the voltage is reduced to 3,000 volts, which is the pressure at which the current is supplied to the cars. The power station contains three turbine-driven, three-phase generators, each running at 150 r.p.m. and giving 1,500 volt-amp. at 20,000 volts, with a frequency of 15 and a power factor of 0.7. Each machine has 12 poles. The installation is described in detail with many illustrations.—*Elektrische Bahnen*, December.

Reference.

Cleaning Third Rails in Open Country.—The third-rail system of the Grand Rapids, Grand Haven & Muskegon Railway Company has been kept free from ice and sleet through several storms this winter by the use of a solution of chloride of calcium poured on the rail through tubes extending from reservoirs carrying this solution, which are located in the motorman's vestibule, to a point directly over the third rail. The flow of the liquid can be regulated easily.—*St. R'y Jour.*, December 26.

Installations, Systems and Appliances.

British Central Station.—An illustrated description of the recently-opened electricity works of Christchurch. The power house contains two steam dynamos, each of 100-kw capacity, running at 450 r.p.m., and giving 500 to 550 volts either as compound or shunt-wound machines for supplying power both for lighting and traction. In connection with the lighting supply, two motor balancers are provided, each of 25-kw capacity. There is also a storage battery of 244 cells, giving 175 amp. for one hour. The pressure across the outers of the three-wire system is 500 volts. For public lighting 65 Nernst lamps of 84 cp and 44 of 42 cp have been installed. At present the equivalent of 1,500 lamps of 8 cp are connected to the mains.—Lond. *Elec. Rev.*, January .1.

Electro-Physics and Magnetism.

Eddy Currents.—Thornton.—The first part of an illustrated paper read before the Newcastle local section of the British Institution of Electrical Engineers. He first describes experiments made with massive cast-iron and steel rings, and then discusses tests of direct and alternating-current machines. From his results it can be concluded that if in any machine the field current shows a synchronous variation caused by armature reaction, of about 10 per cent., there will be a loss in the core by eddy currents, which will be a large fraction of the total losses in the machine. In alternating-current machines the chief source of the eddy current loss in the magnet frame is variation of armature reaction, while in direct-current machines there exist four possible sources of disturbance. The first and most important at light load is imperfect centering of the armature or adjustment of the air-gaps; the second is the variation of reluctance caused by the teeth of the armature moving across the pole face; the third is the slight peripheral shift of the cross magnetizing belt to and fro during commutation; and the fourth is the variation of reaction set up by a rise and fall of armature current, caused by phase swinging or uneven turning movement of the engine. He reproduces some curves taken by the oscillograph, showing the instantaneous distribution of polar magnetism in dynamo electric machines. It is shown that when the brushes of a generator under load are moved backward the magnetism in the gap is caused to oscillate at a speed much higher than that of the machine, and in ripples. These are in a state of oscillation, the amplitude of which is greater with strong fields and for brush positions, which correspond to commutation taking place in a strong field. The effect does not depend upon sparking at all.—Lond. *Elec.*, January 1.

Interruption of the Primary Circuit of Induction Coils.—Turpain and Blondel.—Abstracts of two papers read before the French Association for the Advancement of Science. It is on the rapidity of interrupting the primary circuit of an induction coil that the length of the sparks depends, obtained between the terminals of the secondary, other things being equal. If the interruptions follow each other rapidly enough, the condenser of the induction coil may be left out to advantage. Turpain has obtained similar results with the use of an ordinary interrupter, but constructed in such a way that the interruption takes place simultaneously at different points. Blondel describes a method he has devised of using the alternating current of a supply network without interrupters for operating an induction coil. His device is similar to that of Tesla, a transformer being used, the 110-volt primary of which is connected across the mains, while the 5,000 or 10,000-volt secondary is shunted by a condenser and is connected in series with a spark-gap and the primary of the induction coil to be operated. Every discharge of the condenser produces in the primary of the induction coil oscillations of sufficient rapidity.—*L'Eclairage Elec.*, December 12.

Electro-Chemistry and Batteries.

Electricity Direct from Carbon.—Lorenz and Reed.—Two papers on the problem of getting electricity direct from carbon. Lorenz gives a summary of the theoretical considerations to be taken into account in any attempt of solving this problem and discusses in detail the thermodynamical foundation of the theory of galvanic cells. While a carbon cell is theoretically possible, he believes that much work is still to be done before the problem is solved. Reed discusses in detail the two recent cells devised by Jone (Digest, December 5) and Reid (Electrical World and Engineer, December 12). He considers that the regeneration of the substances in Jone's cell would require an enormous amount of work, and that the mere removal of stannous oxide from the cell and its separation from the electrolyte would cost for labor alone more than the coal would cost for producing the same amount of power by steam. "If we were to ignore losses of material altogether and consider only all the losses of energy occurring in the cycle of processes proposed by Jone, the cost of power would appear to be not less than 50 to 100 pounds of coal for

horse-power-hour. In his criticism of the Reid gas cell Reed discusses all the chemical reactions which can occur in this cell and shows that, if judged from the heat of reaction, the e.m.f. of this cell could not be accounted for electrochemically. "The e.m.f. which is claimed for this battery is, therefore, entirely an almost entirely thermoelectric."—*Electrochem. Ind.*, January.

REFERENCE.

Reviews of Electrochemical Industries.—RICHARDS AND FITZ GERALD.—Two articles giving summaries of the present status of electrochemical industries. Richards discusses the conditions of commercial electrolytic methods and deals especially with the alkali industry and with the refining of copper, lead and gold. Fitz Gerald gives a review of the electric furnace industries in 1903. Much progress has been made in furnace design, and it is probable that in future the electric furnace will be applied to processes requiring only a comparatively moderate temperature, but exact temperature regulation.—*Electrochem. Ind.*, January.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Integrating Alternating-Current Wattmeter.—An illustrated description of a new alternating-current integrating wattmeter of the induction motor type, devised by Ferranti. The aluminum rotable disc, *D*, mounted on the spindle, *S*, and geared to a train of wheels, *C T*, actuating the index hands, serves the double purpose of an armature receiving the driving torque of the meter coils and also the retarding torque of the permanent magnets, *P M*. One shunt coil, *Sh C*, placed round the coil, *C*, of a special tubular electromagnet, *T M*, constitutes the shunt system. The core of this magnet has

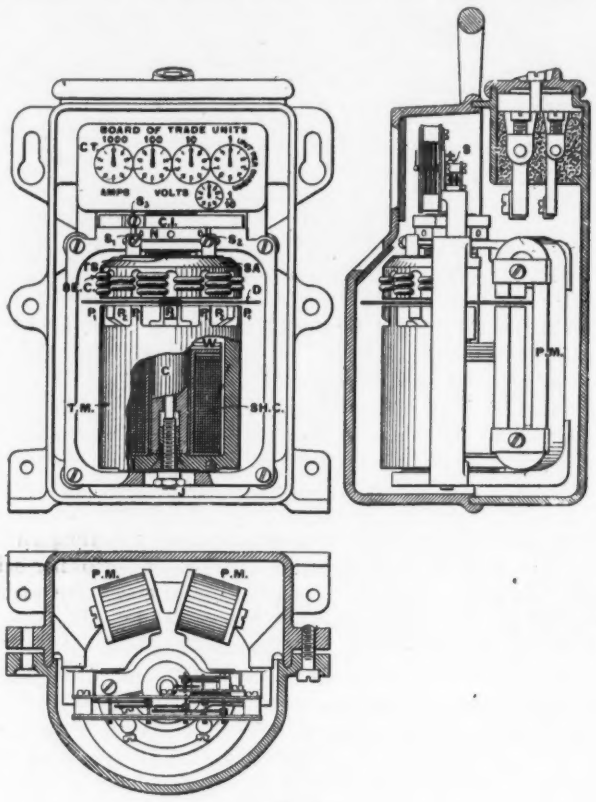


FIG. 2.

three outward radial poles, P^2, alternating with four inward radial poles, P^1, from the shell or tube of the shunt magnet, the plane of these poles being horizontal and parallel to the disc. Since the shunt circuit in the induction motor type of meter must be highly inductive, this special tubular magnet has been adopted, no chocking coils, secondary circuits, resistances or compensating coils being required. The series system consists of a slotted armature, *S A*, above the disc, the series coils, *Se C*, being wound in these slots. The slots of the series armature are almost directly above the poles of the tubular magnets. If the shunt circuit be inductive, the eddy currents produced in the disc by the shunt field will be in phase with the impressed e.m.f. These eddy currents are acted on by the series field, which is in phase with the load current, giving a driving torque on the disc proportional to the e.m.f. of the circuit multiplied by the amperes and by the cosine of the angle of lag of the main current behind the e.m.f., this being the true watts supplied to the circuit through the meter. The retarding torque due to the permanent magnets is proportional to the speed, and the disc, therefore, revolves with a speed which is proportional to the watts. For the purpose of compensating for any dissymmetry in the magnetic system, due to small irregularities in material, workmanship and pivot friction, it is necessary to have some adjustment. The series magnet is left slightly out of center in the direction which gives a slight torque on the shunt alone, and thus can be accurately adjusted to compensate for pivot friction or for any dissymmetry in the magnetic circuit met with in manufacture. The adjustment can be very accurately made by means of the two screws, S^1 and S^2. The constant of the meter is adjusted by lowering or raising the series armature by means of the nut, *N*, on the threaded spindle, *T S*, and after adjustment the series magnet is securely fixed by means of the storing clamp, C^1, and the screw, S^3. The following limits of accuracy are given: 1½ per cent. from 1/10 to full load, and 2½ per cent. from 1/20 to 1/10 load. A 10-amp. meter is said to start with 0.05 amp.—Lond. *Elec.*, January 1.

Localizing Faults in Hooper's India Rubber Core.—OHLSON.—In a cable factory the localization of a fault in an india rubber core often becomes necessary after it has been covered with yarn or metal tape. Occasionally this fault is of high resistance, and cannot be broken down for the purpose of a loop test, even when subjected to great electrical pressure while immersed in water. The author has used the following method with great success for three years: The length is slowly passed through a bath of water or wax at a temperature of about 200° F., and the leakage through the dielectric carefully noted by the deflection of a sensitive galvanometer, using as large a battery as possible. As soon as the fault enters the hot bath the deflection on the galvanometer scale will begin to rise owing to increased leakage through the fault. It will fall again as the fault passes out of the hot bath, so that the operation may be performed several times over at the suspected place to obtain an exact localization. Besides faults of low resistance, due to injury, the most minute imperfections are exactly located by this method, if it is carefully performed. Even in cases where the defect has only been apparent by a slight decrease in the rate of electrification when testing with 1,200 Lèchance cells, giving a galvanometer constant of over 2,000,000 megohms, and the dielectric resistance of even such short lengths as 1,000 or 2,000 yards has been very little altered by its presence, the above method has never failed to localize the defect within a few inches, without breaking the covering of the core.—Lond. *Elec. Rev.*, January 1.

REFERENCES.

Block Signals.—HART.—An article on steam railroad practice in block signalling on double-track roads. The operation of the trains is not dependent upon the block signals, as they are used as an auxiliary only to train orders which are issued by the train despatcher. He thinks that many electric railway companies believe that with block signal systems train despatching, loses its importance, and he wishes to correct this impression.—*St. R'y Jour.*, December 19.

Wave Meter.—DOENITZ.—An illustrated translation in full of the German article recently abstracted in the Digest on an instrument for measuring the wave length of wireless telegraphy waves.—Lond. *Elec.*, January 1.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Douglas Exchange of the Chicago Telephone Company.—An illustrated description of this recently-completed exchange. The general features of the equipment follow standard Bell practice. In addition to the regular equipment, the cords in 33 positions are equipped with coin-collecting keys. The number of answering jacks varies from 60 to 160 per operator, depending upon the class of subscribers served. All positions in the office are equipped with breast plate transmitters which are connected to the switchboard through suitable plugs and cords. The incoming trunk board embodies a new system of incoming trunk lines, whereby it is possible to operate 40 trunk lines per position as compared with 25, which has been the usual practice. The most important feature of this circuit is the absence of any keys. A special relay is placed in the circuit of certain lines and this, in connection with the relays on the incoming trunk lines, automatically selects the proper generator for ringing a subscriber's bell. The trunks have the usual guard and supervisory signals. The subscribers' answering switchboard is arranged in the form of a horseshoe around three sides of the room. It is a standard relay, multiple, central-energy, lamp-signal board and consists of fourteen eight-panel, three-position section, with a present equipment of 3,500 lines.

The ultimate capacity of the board will be 9,600 lines, divided into 19 sections. The board does not differ in its general features from the others operated in the city by the company, except in the use of multiples on four-party lines, a separate multiple being provided for each one of the subscribers on such a line. The ten-party lines are multipled, but restricted to the ten-party line trunk board. The exchange is provided with three overflow positions to equalize the load during the busy hours. "Sick" lines are also provided; these are on the subscriber board and are known as the "hospital positions." The exchange is equipped with one hospital position and 200 auxiliary cords to be used during storm troubles. An information position is also equipped.—*Am. Elec.*, December.

Central Energy Intercommunicating Telephone System.—WEBB.—An illustrated article in which the author shows how the principles employed in central energy telephone exchange systems have also been applied to intercommunicating systems. He describes an arrangement for use with an automatic switch, where centralized talking and ringing batteries and two-line wires for each telephone station are desired or considered necessary. The switch is of the push-button type and is very positive in action, this arrangement being convenient and fully as good, if not better, than a rotating switch, which, in the case under discussion, would have to be double in some way. The author describes a system suitable for a building requiring only three or four telephones and where communication between a central office and the sub-stations only is required. The system is merely intended as a simple substitute for a speaking tube system and is not supposed to meet the requirements of a regular telephone system.—*Am. Elec.*, December.

MISCELLANEOUS.

Patents Expiring 1904.—A list of British patents of interest to electrical engineers which will expire during the present year. Among them are two dry cell patents of Hitchcock and Hellesen, a patent by Langhans for depositing a coating of silicon or boron on incandescent lamp filaments in order to lessen the effect of oxidation, two patents of Ferranti for electricity meters, two patents of Lemp for electric welding, a patent of Lord Kelvin for a mariner's compass, several patents by Weston, Ayrton and Mather for measuring instruments. The manufacture of switches and fuses will be facilitated, it is thought, by the expiry of the patent for the Mordey powder fuse and of the patent of Drake and Gorham relating to spring contacts for switches. A patent of Dobrowolsky and Mamroth for distribution of electricity by a four-wire, three-phase system and another patent by Dobrowolsky for the insertion of resistance in rotors of induction motors for regulating purposes will also expire.—Lond. *Elec.*, January 1.

REFERENCE.

Gilbert.—An illustrated reprint of part of the chapter on electrics from Gilbert's "De Magnete," with notes of S. P. Thompson and an account of the life and work of "Gilbert of Colchester, father of electrical science."—Lond. *Elec.*, December 11.

New Books.

DER ELEKTRISCHE LICHTBOGEN. Bei Gleichstrom und Wechelstrom. By Berthold Monasch. Berlin: Julius Springer. 266 pages, 141 illustrations. Price, 9 marks.

This work—a text-book upon the arc lamp—covering a large amount of ground. There is a short introductory chapter on the history of the arc. Several chapters are devoted to the technics of the arc with direct currents and with alternating currents. Then follow chapters upon the various applications of arc lamps. The final chapters refer to arc lamp mechanisms, projectors, enclosed arc lamps and flaming arcs. A list of German patents on arc lamps and arc lamp applications since 1877 occupies an appendix. The book is clearly written and illustrated. It covers both the theoretical and practical sides of the subject remarkably well, considering the size of the volume. It is excellent as a student's text-book.

DER DREHSTROMMOTOR. By Julius Heubach. Berlin: Julius Springer. 356 pages, 163 illustrations. Price, 10 marks.

This text-book on the rotary field, polyphase induction machine is divided into fifteen chapters which relate to the working theory of the induction motor, with the exception of one chapter which deals with the induction generator.

The treatment is both by diagrams and by algebra, mingled with a few arithmetical cases. The treatment is lucid, the text and diagrams clear and the notation methodical. The vector method of diagrams is applied to the illustrations, but the complex vector treatment is scarcely alluded to in the text. The algebraical analysis is consequently different from that usually employed in the United States.

As a text-book by an engineer for engineers on the single-phase, two-phase, three-phase and polyphase induction machine, the book will have much value. Two chapters are devoted to details of practical construction, and a good index concludes the work.

LABORATORY EXERCISES. Primary and Storage Batteries. By Karl E. Guthe, Ph.D. Ann Arbor, Mich.: George Wahr. 58 pages, 18 illustrations.

This is a small laboratory manual, intended to supplement the study of Carhart's well-known textbook on primary batteries. The laboratory course is laid out for students of electrical engineering, so that advanced exercises which would belong more properly to a course of elechrochemistry have been omitted. Nevertheless, the principal electrochemical problems are well placed before the students. The experiments in the first chapter, intended to show the difference of the conditions under which a system made up of the same chemical substances, may give a thermochemical or an electrochemical reaction, are especially very instructive.

The book is divided into four chapters, the first dealing with preliminary exercises and containing general useful information (for instance, on the purification of mercury). The second deals with the different methods of measuring the e.m.f., the temperature coefficient and the polarization e.m.f. of the cell. The third chapter treats of the methods for measuring the internal resistance, and the fourth chapter deals with time tests. The exercises described in the little book should enable a student to make complete tests of a battery, so that, besides its use for universities, the book may be recommended to any one who intends to enter the employment of a storage battery company, and also to those engineers who are using storage batteries in practice and desire to test their batteries themselves.

A TEXT-BOOK OF ELECTRICAL MACHINERY. Volume I. Electric, Magnetic and Electrostatic Circuits. By Harris J. Ryan, M.E.; Henry H. Norris, M.E., and George L. Hoxie, M.M.E., Ph.D. New York: John Wiley & Sons.

Prof. Ryan's writings have always interested electrical engineers, and the text-book of which the first volume has just been published under his editorship will prove no exception. In clear, concise language the writers lay before the student the elements of the theory of alternating currents in a manner which, in spite of its simplicity, does not lack scientific rigor and accuracy.

The contents of the first volume are divided into ten chapters, headed: "Electricity and Magnetism," "Fundamental and Derived Units," "Periodic Curves," "Complex Quantities," "Laws of the Electric Circuit," "Electric Power," "Magnetomotive Force and the Laws of the Magnetic Circuit," "Rotating Magnetic Fields," "The Electrostatic Field," and "Losses in Electric Circuits." The chapters on units, on complex quantities, on electric circuits, consisting of resistance, inductance and capacity, are written with a didactic skill which deserves our greatest admiration. The chapters on periodic curves, on losses in electric circuits, seem altogether too brief and incomplete. It is much to be desired that the subject of Fourier series be treated by the teacher of electrical engineering rather than by the mathematician, as the wide field of application at the disposal of the engineer is generally a book with seven seals to the mathematician; and if interesting examples are held out to the student as the goal which he can reach only by wading through a mathematical bog, he is much more likely to keep up his courage than he will if he does not know the value and power of the mathematics, which he finds wearisome to study. In the chapter on losses in electric circuits, it is to be deplored that the writers do not give a simple derivation for the electrostatic capacity of parallel wires, as was given by Baum and Perrine in their paper in the *Transactions* of the American Institute of Electrical Engineers, May 18, 1900. The method which Baum and Perrine employ in their paper seems to us to deserve careful attention, and it should be embodied in any text-book in which the electrostatic capacity of long conductors is treated.

It is to be hoped that the remaining volumes of this useful and timely work will soon come out.

The Electric Drive as Applied in a Modern Machine Shop.

The general adoption of the electric drive is a conspicuous feature in the design of modern industrial establishments. A notable installation is the West Allis plant of the Allis-Chalmers Company. As the product of the company, as is well known, consists of the Reynolds type of Corliss engines for all power purposes, pumping and hoisting engines, also flour mill, saw mill and mining machinery, the electric drive is applied principally to the driving of machine tools and the installation, as a consequence, is characteristic of that class of work.

The West Allis plant has been built to increase the capacity of the company's plants and to provide for the future growth, although all of those which were already in operation have been continued. As is well known, these include the Reliance Works, of the former Ed. P. Allis Company, at Milwaukee, the Fraser-Chalmers and the Gates Iron Works, at Chicago, and the works of the Dickson Manufacturing Company, at Scranton, Pa. It is not the intention of the company to supersede the latter, but to confine all future growth to the new plant. Under the conditions existing at the later, and with the modern methods and means employed, the company's product can be manufactured at that point more economically than elsewhere.

The works are situated at West Allis, a suburb of Milwaukee. Two suburban electric lines pass the plant, which is also reached by spur lines of the Chicago, Milwaukee & St. Paul and the Chicago & Northwestern Railroads. As a consequence, skilled labor is readily obtainable from the latter place and has obviated the necessity of building a village for the accommodation of the workmen employed in the shops. The facilities afforded by the connection with the two trunk lines are such that raw materials are readily obtained and the manufactured product shipped to its destination. The site secured contains 100 acres, the plot being about one-half mile wide, and more than one-third mile wide. The soil is a firm clay and has afforded a most excellent foundation for the erection of the buildings and the machinery. It will be possible, because of the extent of the grounds, to increase the capacity of the present plant materially without in any way changing the present lay-out.

In considering the design of the West Allis plant, Mr. Edwin Reynolds, the consulting engineer of the company, decided that the arrangement of the buildings should be such that at whatever time an extension of the plant might be considered, the latter would always constitute a complete unit. It was furthermore deemed advisable that the building of such extensions should in no way interfere with the operation of the plant then existing. These may be considered the governing principles in the design of the plant, although a number of other features have been incorporated, which from an economical standpoint are desirable. To assist in the handling of the material in the various stages of manufacture, the buildings and the equipment have been arranged in such a manner that the least amount of labor is required for the production of a given amount of machinery. This is facilitated by a system of yard tracks connecting with spurs from the railroads and the extensive use of cranes, both in the buildings and in the yards. In fact, the latter feature is a noticeable one in the design of the plant; more than two miles of crane runway have been installed, and some 50 cranes, varying in capacity from one-half to 75 tons, of the traveling, jib, pillar and wall type, are in service. Of these four traveling, ten jib and four pillar cranes were supplied by the Northern Engineering Works. One of the cranes is of Shaw make. The balance of the equipment was furnished by Pawling & Harnischfeger.

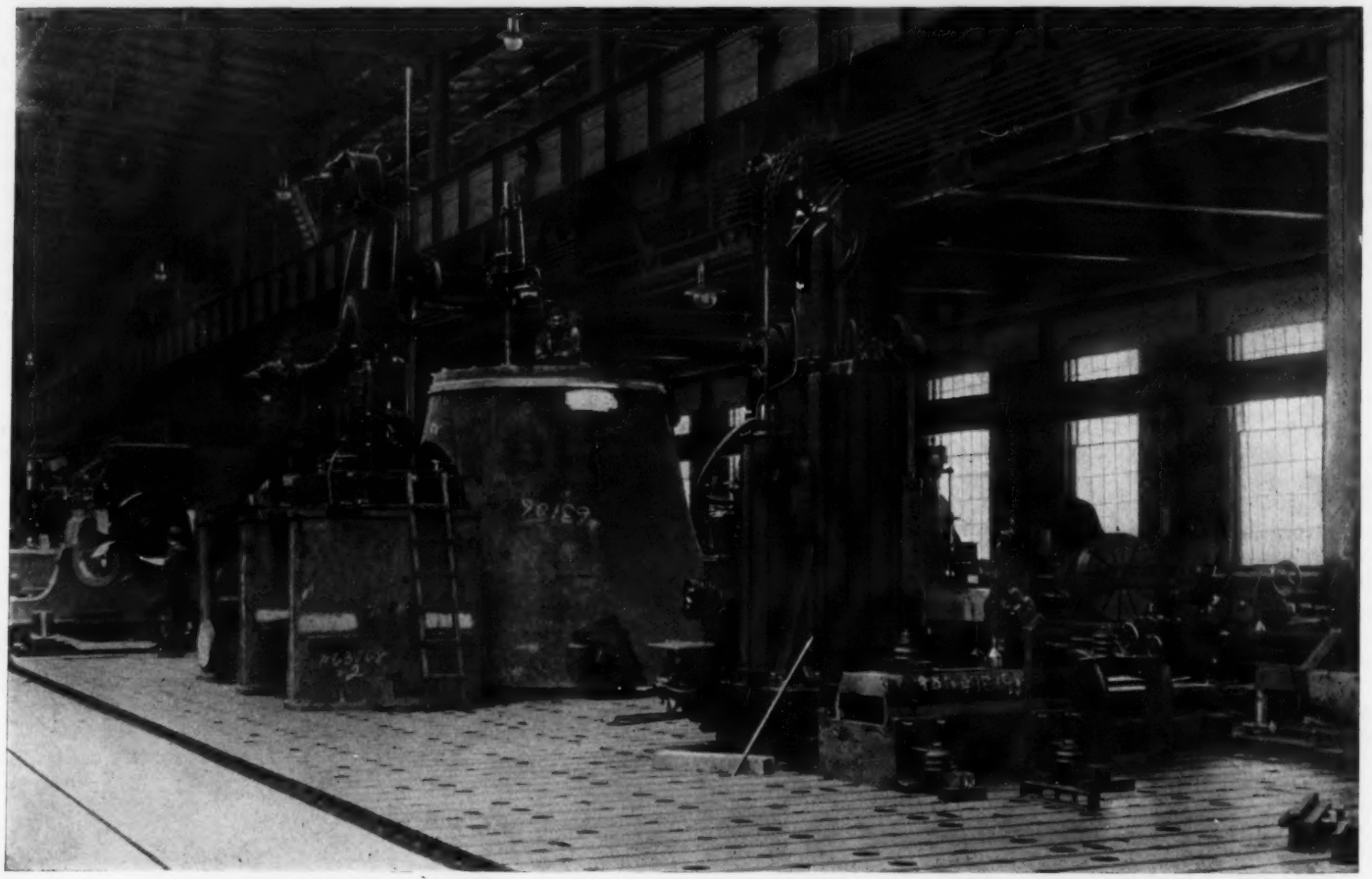


FIG. 1.—ARC LIGHTS FOR TROLLEY AND CRANES. FLOOR PLATE WITH PORTABLE TOOLS IN MACHINE SHOP.

The buildings include at present a storage and pattern shop, a foundry, a blacksmith shop, two machine shops and an erecting shop. Space has been utilized in the blacksmith shop for the power house, which thus is centrally located with respect to the buildings which it serves.

All of the works buildings, with the exception of the machine and the blacksmith shops, are erected in parallel lines, whereas the latter are at right angles with and communicate with the erecting shop. In making extensions, additions will be merely added to the former, but new buildings will have to be erected for the machine and blacksmith shops. In either case it will be seen that such operations will in no way interfere with the manufacturing which is being conducted in the sections previously erected. This is quite important when it is considered that during the erection of such additions, the capacity of the plant will not be cut down and as soon as the additions are completed the output of the plant will at once increase in the same proportion as the increase in capacity.

The buildings are of the steel skeleton, brick curtain wall type of construction, a center bay, with a lean-to on each side, being adopted. The advantages of such a type of buildings have been availed of to place the heavier tools in the main bays, which are

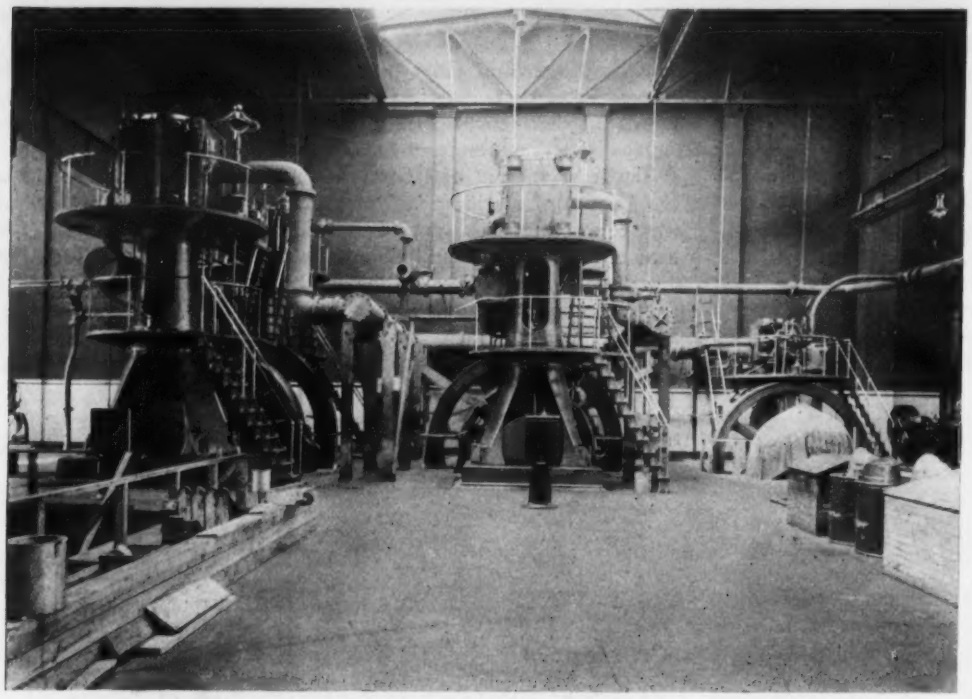


FIG. 2.—INTERIOR VIEW OF POWER PLANT.

commanded by traveling cranes and spur tracks which permit the handling of large and heavy material readily.

The electric drive has been of material assistance in the lighting of the shops, which is further increased by large window areas. Although the buildings have been made as fire-resisting as possible, special attention has been paid to this in the case of the pattern storage building. This is four stories in height, whereas the pattern shop, which is built as a lean-to to it, is but one story in height. Concrete floors are used throughout and fire walls divide the building into sections. The windows consist of wire glass in iron frames, and the roof is covered with the H. W. Johns-Manville Company's asbestos roofing. The various buildings are separated from one

FIG. 3.—ELECTRICALLY-DRIVEN BORING MILLS.

another by ground areas of such extent as to serve as storage places for material.

The power scheme for the works is of unusual interest, as revealing a tendency to depart from generally accepted practice. Whether in the construction of power plants for electric light stations or for industrial establishments, it has been the usual course to unite all sources of power in one location. In this instance, however, the works as laid out will eventually have two independent power plants. Such a course has been deemed advisable as certainty of operation has been considered of greater importance than any economy which might result from the concentration of the two plants in one. It, of course, will be readily appreciated that power in such an establishment, although not an insignificant item in the cost of production, nevertheless is not the most important one. Although with modern motor-driven tools, the possibility of a shut-down is not as great as formerly with line shaft-driven machinery; nevertheless, the possibility of an accident to the power plant itself is a factor not to be disregarded,

Except in a few cases where it was not advantageous to do so, the electric drive has been used exclusively. As a large part of the machinery consists of variable-speed tools, and also because of the extensive use of cranes, direct current has been used exclusively. Current is generated at the power house at 250 volts and by means of compensators, a voltage of 110 and 220 is maintained on a three-wire system for the lighting load. For power work, the four-wire system of the Bullock Electric Company is used, balancing sets being installed in the various buildings to furnish the several voltages required. Compressed air is furnished for a few pneumatic tools, where electrically-operated tools would not meet the requirements. Hydraulic power is also used for several of the elevators, but in such cases electrically-operated pumps have been installed at the point where the power is required.

The power house, as already noted, is located in a part of the building devoted to the blacksmith shop. The boiler room at present contains five 300-hp, 96-in. x 24-ft. Reynolds vertical tubular boilers. Provision has been made for installing coal-handling apparatus and mechanical stokers. Coal is delivered in the boiler room on cars

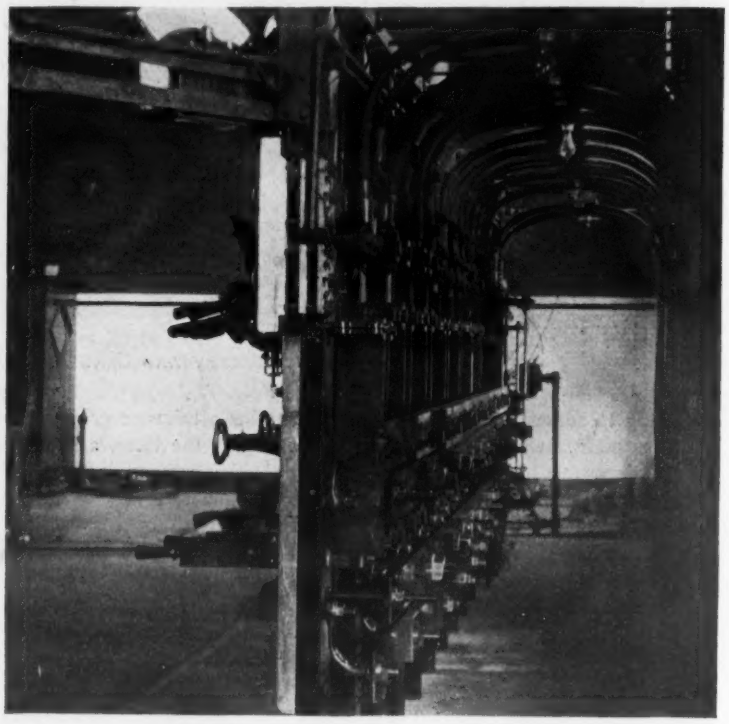


FIG. 4.—REAR OF SWITCHBOARD IN POWER HOUSE.

run in on a spur track which connects with the general yard system. Steam is generated at 125 pounds and aside from the engine room is also supplied to several steam hammers in the blacksmith shop. An 8-ft. stack, 175 ft. high, of the Alphons-Custodis Construction Company's type, has been built.

The engine room contains one 550, one 250 and one 100-kw direct-

connected unit, with space for two additional 550-kw units. The engines are of the Reynolds-Corliss vertical type, made by the Allis-Chalmers Company. The smaller engine, although of only 100-kw capacity, has been especially built to conform to the larger units, in type and speed. The engines are non-condensing, the exhaust being used in a hot water heating system, installed by Evans, Almirall & Co. The generators are 250-volt machines, of General Electric and Crocker-Wheeler make. Two Bullock compensators of 12½-kw capacity are installed to maintain the neutral of the lighting system.

The switchboard, although not embodying any unusual features, is of a most substantial construction. Special attention has been given to the finish of the various instruments and the apparatus which has been used in its construction. The special castings which have been used for connecting switch and instrument lugs with the various bus-bars are of special design, and have been buffed so as to receive a high polish. Pressure and other wires on the back of the board are carried in pipes to various points as required. Two sets of bus-bars are provided, so that if necessary the lighting and power circuits can be operated independently of each other. In the generator and the power circuits both switches and circuit-breakers have been employed, whereas for the lighting circuits switches are dispensed with entirely. In order to obtain as compact a board as possible, the I. T. E. circuit-breakers were specially constructed for this installation. The main coil, switch and tripping devices are in line and are operated in gangs of two or three, as required by the various circuits. A Thomson recording wattmeter measures the output of the station; a Bristol recording voltmeter has been installed to record the fluctuation in the voltage on the lighting circuits. The instruments and switches are all of antique copper finish as well as the grill, which is seen below. The switchboard was designed by Mr. Alvan Dings, the electrical engineer of

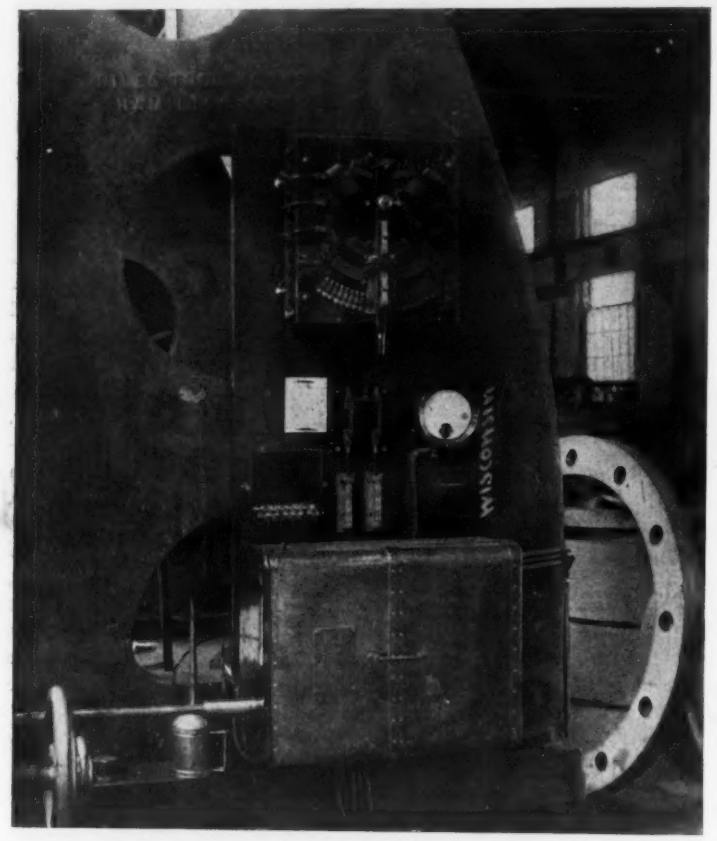


FIG. 5.—CONTROLLER AND AMMETER MOUNTED ON BORING MILL.

the company, and was made by the Milwaukee Electric Railway & Light Company.

Separate feeders are provided for the power and the lighting load for each building. The feeders consist of Standard Underground and General Electric lead-covered, paper-insulated cables, drawn into a conduit system built of Camp tile; 70 ducts leave the station. The underground system is built in a most approved manner and conforms to the practice of the larger electric lighting companies. The conduit is run into the various buildings to a point level with the floors and after the cables have been pulled in is closed up so that foreign objects cannot be introduced. The cable rack at the station, although built of iron, is covered with split tile, so as to afford sufficient insulation for the cables.

The various buildings are lighted by incandescent and constant-potential arc lamps. The latter are hung in alternate panels on each side of the main bays of the various buildings. In the machine and erecting shops arc lamps have also been hung to light the galleries. This doubles the illumination of the main bays as compared with the lean-tos or the galleries. Incandescent lamps either as pendants or in fixtures are distributed wherever required. To

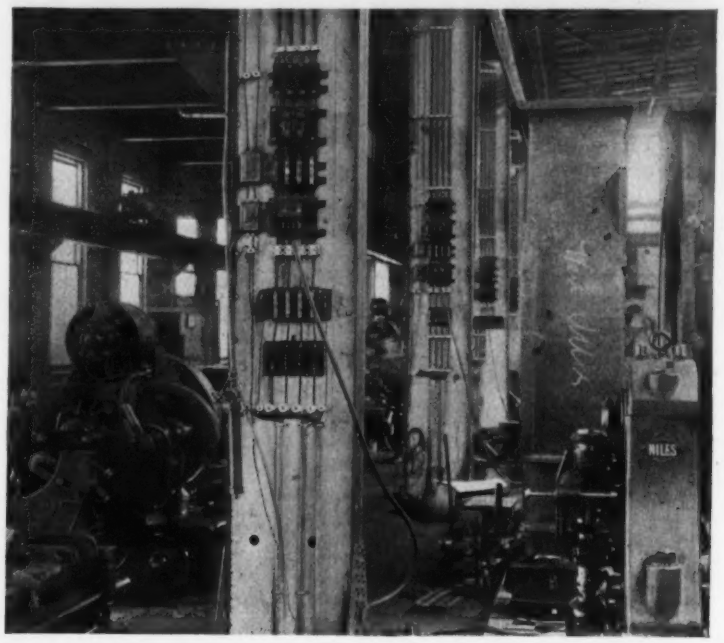


FIG. 6.—POWER CIRCUITS FOR PORTABLE TOOLS.

facilitate work, especially on the larger tools, one or more receptacles are placed on each column, thus permitting the use of extension cords.

The lighting feeders for each building, as already noted, are run independently of the power circuits, directly from the switchboard in the power house to a panelboard installed in each lean-to of each building. From this board circuits are run to various panelboards which control the incandescent and the arc lamps in any one part of a building. The incandescent lamps are controlled from panelboards, of which there are two to each floor and each side of a building. The corresponding arc lamps, however, are controlled from but one such board. All circuits are fused, including the neutral, but not the latter at the centers of distribution. Any section of a building can thus be readily cut out or lighted at will. Enclosed fuses are used exclusively and are refilled by the company's employees. A small repair shop is maintained in which all work required, either for the repair of a motor or any other part of the electric installation, can be readily attended to. The general lighting of the buildings is of the best nature, as very little fluctuation occurs in the voltage due to variations in current for the power circuits, even with the number of cranes which are constantly in operation. The arc lamps are partly of General Electric make, whereas the balance were furnished by the General Incandescent Arc Light Company.

The power feeder for each building is run to a center of distribution, at which the balancing sets for the Bullock four-wire system are installed. As will be seen from the accompanying photograph, the switchboard installed at such points contains the necessary switching apparatus and meters. The ammeters of which one is installed in each leg of the four-wire system are of the differential type, so that the amount of power and the unbalancing in each circuit can be readily determined. The Bullock four-wire system, as is well known, gives six voltages. To prevent mistakes being made, a code has been adopted whereby the east, south and upper wires are always positive. All wiring below and to a distance of several feet above the floor is run in Richmond conduit. For all machinery permanently installed, the wires are run through conduit to such machines. For portable tools, a special receptacle has been installed on the building columns to permit of power being delivered

wherever required. As will be seen in the accompanying illustration, the north side of each column has been covered with dressed boards, to which the wiring and other apparatus is firmly attached, and which at the same time serve as insulation. The receptacles for power work deserve special mention, as it was found necessary to develop a design which would meet the conditions existing at the plant. These will not heat with any current required for operating the tools. Their construction, furthermore, is such that the plug must always be inserted in the same way, which prevents a motor from being connected up in any other than the proper way, and without any special thought on the part of the men.

The larger motors of the variable-speed type are equipped with a Bullock controller and, in addition, with an I. T. E. circuit-breaker and a Jewell ammeter. As the frequent blowing of a fuse has been found objectionable, circuit-breakers were installed, which, of course, can readily be closed when the circuit is opened. The ammeters serve a most useful purpose in showing the workman the load which he is carrying, and thus permit the carrying of an overload within limits when necessary, without opening the circuit-breaker. The ammeter reading also at all times indicates whether or not the workman is working his machine to its full capacity. The controllers are placed at such points or mounted directly on the machines, so that the workman at all times can start or stop the machine readily. In the case of lathes with very long ways, the controller can be operated from the tool rest through a spline shaft. In the latter case, a separate series motor has also been provided for operating the carriage travel. In the case of lathes and some other machinery, motors have also been provided for actuating pumps delivering soda water, etc., to the tools.

In nearly every case, each tool is operated by its own independent motor. Group drives have been used in but a few cases where the tools would not readily permit of any other arrangement. In the case of the larger tools, as the boring mills, several planers, etc., two and three motors are provided for various operations. In a great many of the tools the motors are mounted directly on these and drive the former through gears. In other cases the motors, although mounted on the machines, are belted to these, whereas in several instances the motors are placed at some convenient point. Bullock motors are used on the multiple voltage system. Because of the inability to obtain equipment as required, motors of nearly every make are used throughout the plant.

The feeders for the cranes are taken from the centers of distri-

FIG. 7.—SWITCHBOARD AND BALANCING SETS.

bution in the various buildings without the intervention of switches or circuit-breakers except those at the power house and the circuit-breaker installed on the cranes themselves. One trolley wire which is of the figure 8 section, is placed on each side of the crane runway. A feeder is tapped into this at about a quarter of the distance from each end and every 75 ft. between. The trolley wires are fastened with giant strain insulators and eye bolts and supported every 20 ft. by a clamp fastened to a bolt which has a vertical movement. The bolt is insulated by fibre from the supporting bracket and the whole is fastened to a wood block, secured to the girder runway. In the yards a similar construction is used, with the exception of an insulating bell in place of the giant strain insulators. The collecting wheels on the cranes pick up the trolley wire, thus preventing any serious strains on the latter and also any undesirable flashing. The crane equipment proper is of standard make as supplied with the cranes by the various manufacturers.

A five-ton electric telpher furnished by Pawling & Harnischfeger, has been installed in the pattern shop to facilitate the handling of patterns within the building.

The feed water pumps in the power house are electric-driven. The operation of these has been made automatic in the following manner: In a by-pass around the pump, which connects with the source of supply and the boiler feed pipe, a valve is inserted, which is operated at a higher pressure than that which is maintained in the boilers. As the pressure in the boilers increases, the pump which operates continuously, increases the pressure in the by-pass until it

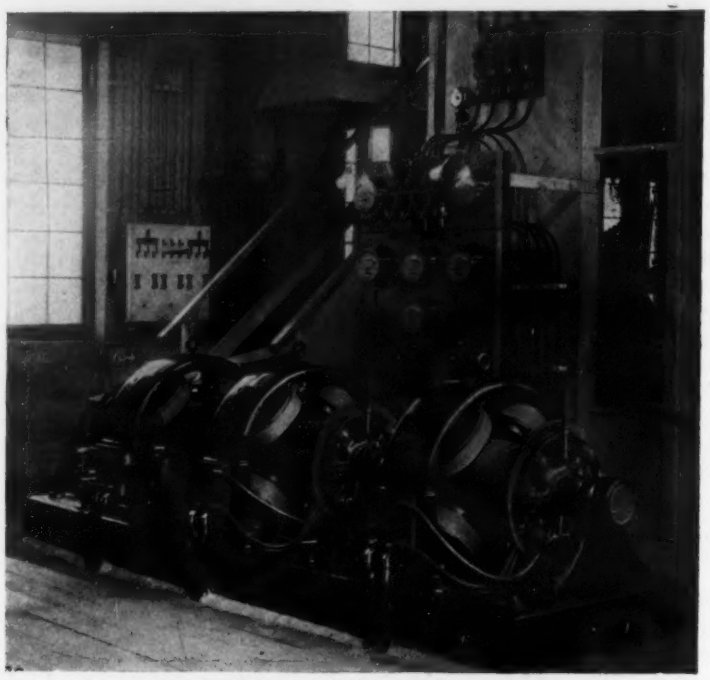


FIG. 8.—BALANCING SET AND SWITCHBOARD.

opens the valve located in the same. This, of course, is a waste of energy, as the pump then merely circulates the water in a circle. To prevent this a gauge similar to a steam gauge, which is provided with two concentric rings, has been connected in the by-pass. As the pressure increases the pointer finally reaches a point where it closes a secondary circuit, which in turn opens the motor circuit.

Several deep well pumps, made by the Downing Pump Company, which are installed at several artesian wells on the company's property, are operated automatically by Cutler-Hammer switches, which are actuated by floats, placed in several cisterns near the power house.

Various tools used about the plant are also electrically operated, among which may be mentioned electric drills of the Hisey-Wolf Machine Company; electric drills, center grinders and hack saws, made by James Clark, Jr., & Co., and babbitt melters and glue pot heaters, made by the United Electric Heater Company. The cranes operated in the yards are heated by electric heaters furnished by the same company. Several portable sand sifters and mold drivers are also electrically operated.

New Sturtevant Plant.

One of the features of the new plant of the B. F. Sturtevant Company, at Hyde Park, Mass., peculiarly indicative of the permanent character of the new works now under construction, is the steam tunnel 4½ ft. in width and 6½ ft. high, extending from the power plant to the most remote part of the manufacturing buildings, a total distance of about 800 ft. The tunnel, which is of concrete construction, will not only accommodate all of the steam piping, but also the electric wires for power, light, telephone, standard time clock, and other service, together with oil, hot water and other pipes for general distribution to the various buildings of the plant. None of these features of the equipment will be carried above ground at any outdoor point.

The New York Automobile Show.

This is Automobile week in New York City, and the fact is as palpable and evident as Horse Show week is. Uptown, particularly in the vicinity of Madison Square Garden, the automobile is conspicuously numerous, while in every hotel, restaurant and café of the fashionable quarter well-known automobilists are to be seen aplenty. As for the Garden itself, the show given there under the auspices of the Automobile Club of America and the National Association of Automobile Manufacturers, is a brilliant success. The fourth annual show is an advance over all its predecessors in the shape of exhibits, attendance, sales and general public interest, although it cannot be said that any particular novelty is to be encountered. In fact, the art would appear to have become rapidly standardized in regard to many of its essentials, and freak ideas or machines are disappearing. The present show closing to-night, Saturday, has had on view, aside from innumerable specialties and supplies ranging from sprocket chains to goggles, no fewer than 250 automobiles, including 181 gasoline, 46 electrics, 11 steam and 12 motor cycles. These figures represent very closely the relative magnitude and importance of the three motive powers, as thus far developed, though it is probable that no one would predict very boldly as to their ratio in the years to come. A great many of the electric automobiles shown are of the commercial type, an encouraging fact for the builders and for the manufacturers of storage batteries. We illustrate herewith some of the leading groups of electrics.

THE EDISON STORAGE BATTERY COMPANY had a very interesting exhibit of a set of 20 of its cells in a Baker Electric Stanhope, which was exhibited under the competent charge of Mr. Bee, who stated in connection with this set that owing to recent improvements Mr. Edison has again greatly increased the capacity of the cell, adding to its desirability for automobile work.

THE ELECTRIC STORAGE BATTERY COMPANY OF AMERICA had a small but adequate and interesting exhibit in the space of the Electric Vehicle Company. It showed three types of cell, chief of which was the express cell intended specially for heavy work, such as drays, trucks, etc. This battery was opened up so that the interior construction and the nature of the basswood and rubber separators, etc., could be observed. The lugs on the plates are extremely substantial and heavy. The second type shown was the latest form with heavy lugs for ordinary automobile work, and the third type was a very compact little set devised for sparking purposes on gasoline and other hydrocarbon vehicles. All of these are in extensive use to-day. Other sets of Electric Storage Battery Company's cells were to be found around the exhibition, notably one in the space of the General Electric Company, being charged by means of alternating current taken through a mercury arc rectifier.

THE GENERAL ELECTRIC COMPANY had a most interesting and comprehensive exhibit at the Fourth Avenue end of the hall, comprising its new motors, controller, panelboard, etc., details of which are given elsewhere in this issue, and particularly its novel form of mercury arc rectifier. Under the care of Mr. A. Churchward a set

FIG. 2.—EXHIBIT OF NATIONAL ELECTRIC AUTOMOBILES.

was shown of apparatus including a rotary reversed, taking the direct current of the house and delivering single-phase current to the mercury arc rectifier, whose operation could be witnessed through glass. This rectifier straightened out the current and delivered it to a set of Exide cells and the quantity of current going into the battery could be noted from the indicating instruments on the board. This attracted a great deal of attention, especially as experiments were made to show flexibility under a range of frequency and under other varying conditions. Mr. Churchward stated that he had been charging storage batteries for practical work in this way for six months past.

FIG. 1.—GENERAL VIEW OF THE AUTOMOBILE SHOW, MADISON SQUARE GARDEN, NEW YORK.

The Baker Electric Vehicle Company had a very interesting display, containing possibly the greatest novelty in the direction of electric vehicles, one with the Elwell-Parker motor placed in the front hood usually occupied by the gasoline engine and driving at right angles on the axle shaft by means of beveled gearing. The vehicle was a surrey equipped with a 2½-hp motor and 24 cells of storage battery.

The Electric Contract Company showed a line of its dry batteries and sparking outfits. The exhibit was in charge of Mr. Skinner.

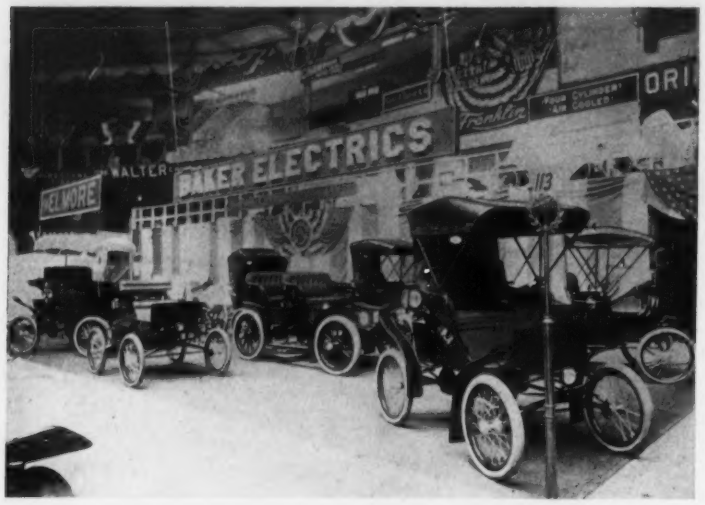


FIG. 3.—BAKER ELECTRIC VEHICLE EXHIBIT.

Meyrowitz Manufacturing Company had an exhibit of eye glasses and shades for automobilists.

Dayton Electric Manufacturing Company showed the Apple Igniter, which has become so deservedly popular for sparking purposes on gasoline vehicles.

National Carbon Company batteries, etc., were shown in a handsome booth.

FIG. 4.—EXHIBIT OF ELECTRIC VEHICLE COMPANY.

Dow Portable Electric Company, Boston, had dry batteries and sparking outfits on exhibition.

C. F. Splitdorf showed his well-known coils in a well-arranged exhibit.

Mr. F. A. La Roche, the well-known electrical manufacturer, showed a full line of French Darracq automobiles for which he is American representative.

Emil Grossman showed a line of jacks. He was admirably represented by Harry M. Shaw, well known in electrical circles.

Messrs. A. G. Hyde and Wallace L. Howard represented the Whitlock Coil Pipe Company, of Hartford, Conn.

The United Electrical Manufacturing Company had dry batteries on exhibition.

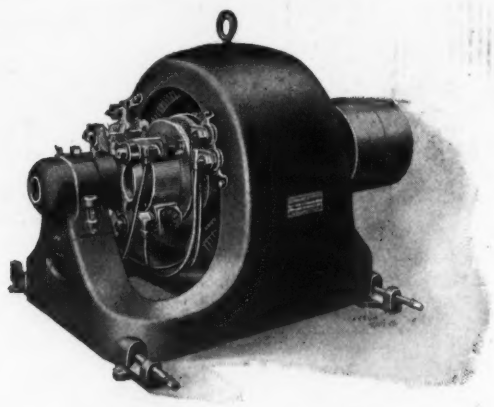
Messrs. Rushmore and Poiner, of the Rushmore Dynamo Works,

FIG. 5.—NEW TYPE OF ELECTRIC AUTOMOBILE.

exhibited their searchlights, which are finding extensive use on automobiles.

Direct Current Dynamos and Motors.

A line of direct-current machines, of bipolar and multipolar design, is being introduced by the Hertner Electric Company, of Cleveland, Ohio. These machines range in sizes from ¼ to 15 hp and are adapted for lighting, power and elevator work. Electrically the intention of the designers seems to have been directed towards making the magnetic circuit of the field as stiff as possible, resulting in a decrease in the speed or armature turns, or both, to the great advantage of the overload capacity of the machines. In most respects the design is similar to that of standard machines now on the market, particular attention being paid to the production of a



DIRECT-CURRENT MACHINE.

mechanically symmetrical construction. Several novel devices are resorted to in order to insure perfect freedom from oil on the inside of the commutator. The company is making a specialty of furnishing motors for extraordinary service.

These machines, it is stated, have been used with marked success in certain classes of printing press work where the speed variations are wide. The brush-holder is of a somewhat novel type. It is claimed that it overcomes the chattering of the brushes and the sticking to the face of the holder. The only moving parts are the brush and a very light finger, so that the motion of the commutator will be readily followed.

General Electric Exhibits at the New York Automobile Show.

The exhibit at the show of the General Electric Company were electric motors of new and improved design, a motor-generator charging set, a large and small Lemp steering check, a controller for electric vehicles using one motor, a standard controller for electric vehicles using two-motor equipments, a charging panel, a switchboard, a single-phase rotary converter and a mercury rectifier. The exhibit occupied a space at the right-hand corner of the south aisle at the Fourth Avenue end of the Garden and was handsomely decorated.

It is obvious that where the power to run the motor is derived from batteries carried in the vehicle and not from practically an unlimited source of power, such as the overhead trolley supplies, that the electrical qualities of such a motor should receive very careful attention. The qualities are of low cost and light weight, of course, desirable but not at the expense of high torque efficiency and proper speed characteristics at all loads. If the motor be too light it lacks proper structural strength, and its life is consequently short. If a motor is to have the proper electrical efficiency a certain amount of iron and copper must be provided in order to obtain increase of torque for the given current input and decreased heating effected.

The new six-pole General Electric automobile motor known as the G.E.-1010 and G.E.-1011, now exhibited for the first time, approaches very nearly to theoretical possibilities in its speed, torque and efficiency characteristics and the relationship between them. The torque for a given current is relatively high and increases in correct proportion as the current increases. It also keeps up its efficiency when a large torque is required, such as starting, hill climbing or running on bad or muddy roads. The field rings of this new class of motors are made of cast steel. The pole pieces are of laminated iron and the coils are machine wound and thoroughly water-proof. The commutator segments of the armatures are deep and wide, giving high conductivity and perfect radiation of heat at overloads as well as insuring long life and freedom from sparking.

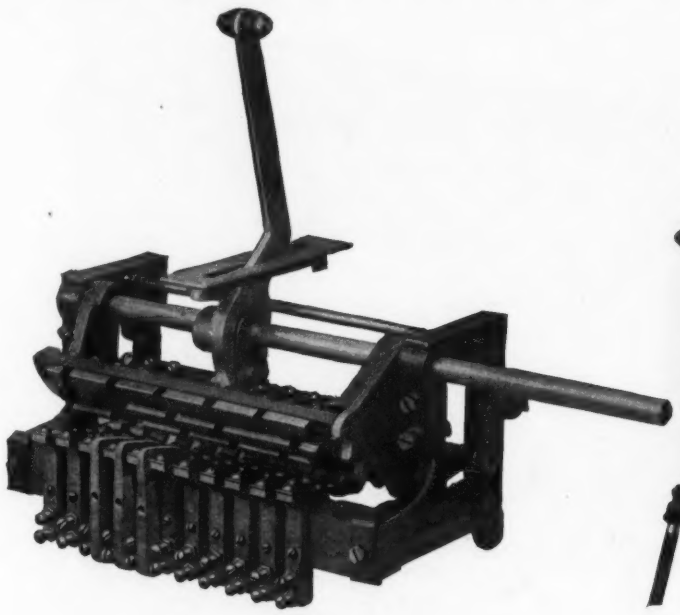


FIG. 1.—CONTROLLER.

In order to decrease the cost of repairs, the armatures of these motors have been built on quills so as to facilitate removal. The oil ring bearings have been standardized in a form similar to those so successfully employed in street railway service. The shafts have been made of a specially high grade of steel, and the journals are large, insuring minimum attention, and are protected from dirt and grit by a perfected form of dust-proof packing.

As many parts as possible of these new motors have been standardized and are, therefore, interchangeable. Any size of motor may be fitted with or without axle arms, according to the desire of the customer as to the method of suspension.

The charging panel shown in the General Electric Company's exhibit is fitted for one 2-hp, three-phase, 60-cycle induction motor connected to 1-kw, 110-volt generator. The equipment of this panel consists of a four-pole circuit-breaker, two lamps with bases to be used as polarity indicators, one pocket voltmeter, 10-amp. capacity; one pocket voltmeter, with 120-volts capacity; one starting rheostat, two fuses, one plug switch and one resistance for low-voltage coil.

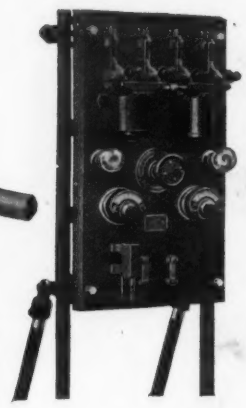


FIG. 2.—CHARGING PANEL.

To supply the demand for a small charging set for automobiles, that can be operated by any standard single-phase circuit, the General Electric Company has placed on the market a single-phase self-starting rotary transformer that can be operated successfully on both 60 and 133-cycle circuits. This type of single-phase rotary is self-starting, with less than full-load current, and the starting mechanism is automatically changed from the starting to the synchronous running position.

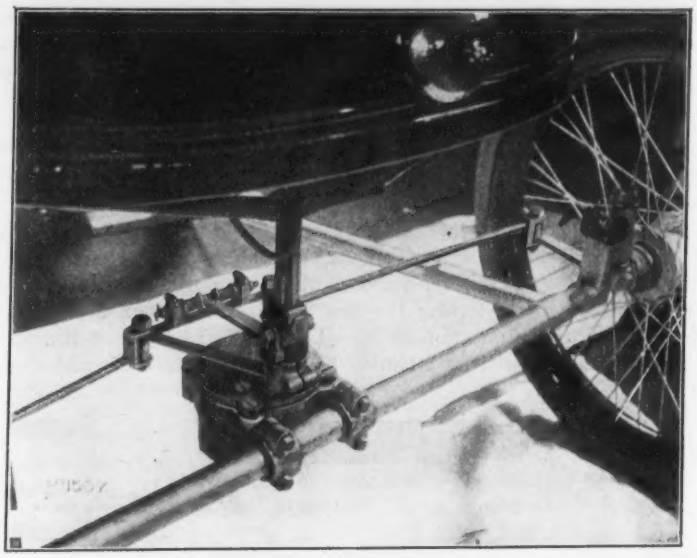


FIG. 4.—STEERING CHECK.

Up to the present time it has not been possible to build an efficient and satisfactory single-phase rotary transformer without the use of some dampening or anti-hunting device. The Churchward anti-hunting device has been in successful operation for a number of years, both 60 and 133-cycle rotaries operating on single, two and three-phase currents. All these new single-phase rotaries are equipped with the latest improvements on this device. The present standard outfit will give the following range of e.m.f. without the use of resistance: 90-120 volts, 45-60 volts at full load.

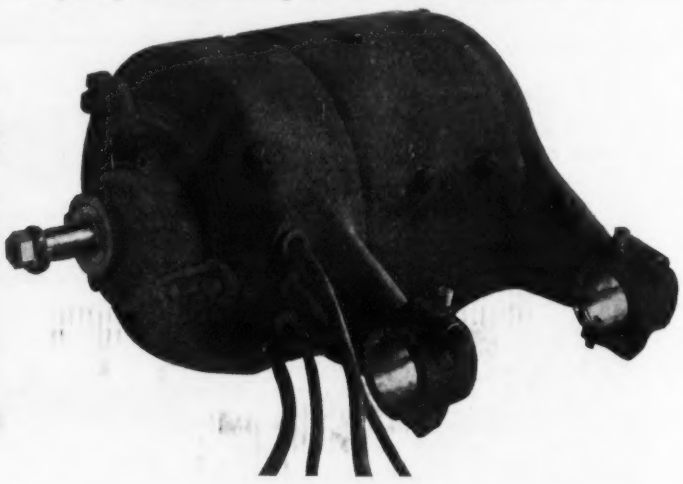


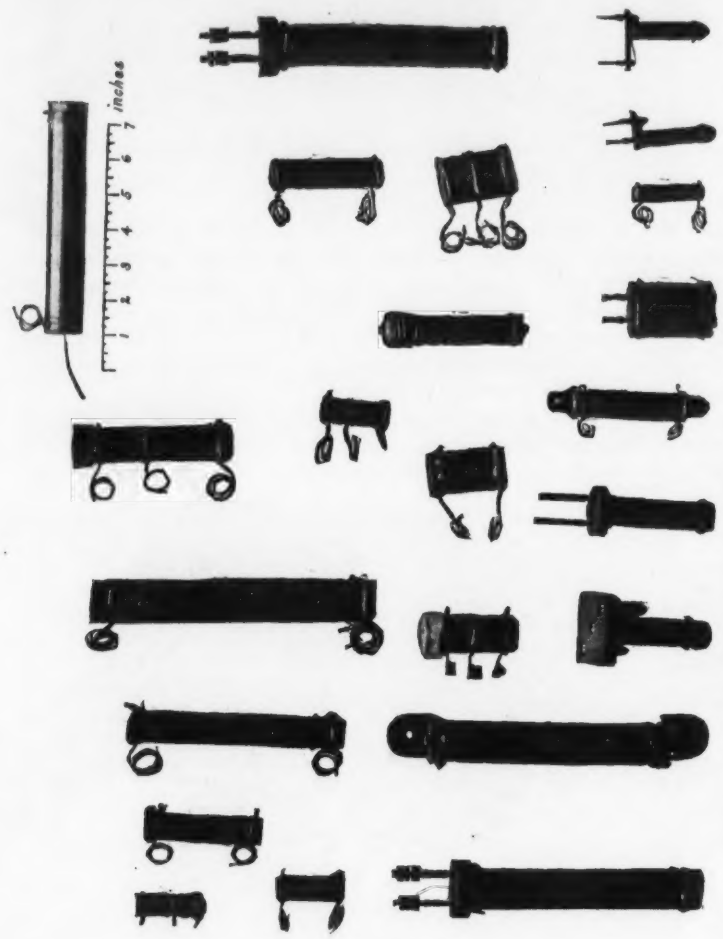
FIG. 3.—MOTOR.

For localities where the owner of a small electric automobile has great difficulty in arranging charging facilities, or the expense and care of a gas engine or motor-generator is too great to be considered the General Electric Company has developed a mercury arc rectifier suitable for charging the common runabout of 20 to 30 cells under all ordinary conditions of usage. The two principal features of the rectifier outfit are, first, a vacuum tube in which the conversion takes place, and, second, a reactance, the function of which is to secure stability of operation and to give a ready means of varying the load. The operation of the rectifier is most simple. On inserting the battery plug and closing the line switch, the vacuum tube automatically lights, and as soon as lighted the battery begins

to receive its charge, the amount of current being regulated by the dial switch on the face of the compensating reactance mounted on the top of the panel. The capacity of this rectifier is 10 amp., this being a rate of charge at which an automobile, in case it is fully run down, may safely be left charging all night. Inasmuch as the rectifier is so simple to operate and requires no attention, there should be little excuse for vehicle owners ever being caught with an empty battery. If, during the time of charging, the power should go off, charging ceases, to automatically recommence as soon as the circuit becomes alive again.

Resistances in Telephone and Telegraph Practice.

As the telephone and telegraph service is of vital importance in quick modern business transactions, anything which promises increased efficiency in this service is worthy of being given the closest investigation and of having the best engineering talent devoted to the solution of the questions involved. The Ward Leonard Electric Company has devoted its attention to the specific task of producing



RESISTANCE COILS.

a compact unit, of high resistance and moderate current-carrying capacity, combining in a small space the salient features of a strong, durable telephone or telegraph resistance unit.

The cuts show units made of wire enameled on porcelain tubes, possessing the following advantageous features: The resistance wire is imbedded in a material which will expand and contract at the same rate as the resistance itself within the limits of usage, thus preventing the adjacent coils from closing together and short-circuiting, preventing, therefore, a change in the resistance of the unit which might cause a burn-out in the circuit. The enamel in which the wire is imbedded and by which it is entirely covered, protects the wire from the atmosphere. As the entire wire is hermetically sealed, it cannot deteriorate owing to the action of moisture or other corrosive elements. The coating of enamel over the wire is so thin and the enamel so good a conductor of heat that the heat generated is dissipated very rapidly because the radiating surface is practically increased from that of the fine wire to that of the porcelain tube. The resistance wire has a zero temperature coefficient, that is, its resistance, does not alter with change of temperature, the importance of which is well known.

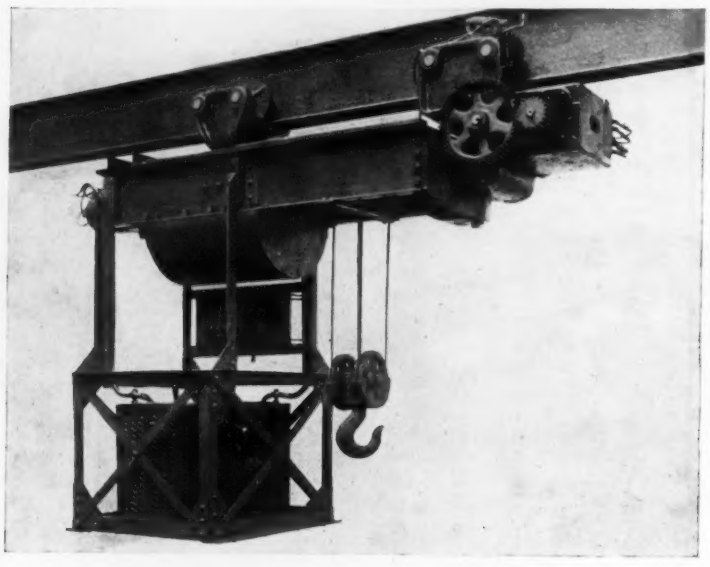
These units are very strong mechanically, are small, compact, non-abrasive, rust-proof, water-proof, fire-proof and dust-proof. The terminals are very strong and the connection between the resistance wire and the terminal head is embedded in the enamel, which preserves the joint against any depreciation. The shape is the best possible for mounting in practice, as will be evident from the cut, which shows units designed for mounting in cord circuits in telephone exchanges. They are 2 in. long by ½ in. diameter and can be wound for any resistance from five ohms to three-hundred.

The cut also shows units designed for ringing circuits in telephone exchanges. The resistances are 3¼ in. long by ¾ in. diameter. They can be wound for any resistance from five ohms to seven hundred ohms. The cut shows 650-ohm units arranged for mounting in Edison sockets, mounting against the wall of a section or for mounting on a slate panel.

Ward Leonard Electric Company's engineers solicit the opinion of telephone and telegraph men and would gladly take up any problems of design, mountings, etc., which they may suggest. The Postal Telegraph Company, always progressive, has adopted these units of a larger size for their circuits and in the construction of their rheostats.

Electric Traveling Hoist.

The engraving herewith illustrates the new electric traveling hoist built by the Niles-Bement-Pond Company, of New York, at its Philadelphia crane department. These hoists may be equipped with a cage as shown, or may be arranged to be operated from the floor by means of pendant controllers. The hoisting mechanism is placed between the channel framing of the trolley and is direct-geared to the drum, a standard load and motor brake being provided. Power



ELECTRIC TRAVELING HOIST.

for hoisting, in all cases, is furnished by electric motors, while the trolley travel may be arranged for by motor or hand racking. This type of hoist is built in three sizes of three, four and ten-tons capacity. Swivel trucks will be furnished for use on curved tracks.

New Engineering Firm.

The Beardsworth Engineering & Machinery Company, Cleveland, Ohio, has been formed to act as electrical engineer and selling agent for electrical equipment. The company will make a specialty of selling and re-installing complete second-hand power plants that are fully guaranteed by those who wish to dispose of the same. It has a number of complete plants for sale in various parts of the country. Parties having steam and electrical equipment too small for their present requirements can make advantageous exchanges through this company.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was irregular in its tendencies, being influenced largely by the conflicting reports of the situation in the Far East, and the nervousness of the European markets. United States Steel issues were stronger, and Brooklyn Rapid Transit and similar stocks were rather heavy. The firmness in Steel preferred and sinking fund bonds was due to absorption from many sources, the West being again a liberal buyer. Tractions and Electrics were neglected, and weakness characterized the market for this class of securities. General Electric was almost entirely neglected, only 80 shares having been reported sold during the week. The price, however, kept quite steady, ranging from 173 to 175, and closing at 174. Westinghouse common closed at 168, being a loss of 4½ points net. Western Union closed at 87¾, which is ¼ point off. Commercial Cable, on sales of 546 shares, closed at 183½, this being a net gain of 15½ points. American Telegraph & Cable gained 3⅞, closing at 85⅞. Among the tractions Brooklyn Rapid Transit closed at 48½, a net loss of 2¼ points, the sales aggregating 73,100 shares. Metropolitan Street Railway closed at 121, a net loss of 1 point. In Boston notable strength was displayed at the end of the week in Massachusetts Electric, Edison Electric Illuminating and the copper shares, while the general market was steady. Following are the closing quotations at New York of January 19:

NEW YORK.

	Jan. 12	Jan. 19		Jan. 12	Jan. 19
American Tel. & Cable	85½	85	General Electric	173	174¼
American Tel. & Tel.	124	126	Hudson River Tel.	..	..
American Dist. Tel.	25	22	Metropolitan St. Ry.	120⅝	122⅛
Brooklyn Rapid Transit	49⅛	50⅛	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	176¾	..	N. Y. & N. J. Tel.	..	..
Electric Boat	17	18	Marconi Tel.	..	..
Electric Boat pfd.	45	45	Western Union Tel.	87⅛	87⅞
Electric Lead Reduction	1	1	Westinghouse com.	165	170¾
Electric Vehicle	9¼	8¾	Westinghouse pfd.	185	190
Electric Vehicle pfd.	13	14			

BOSTON.

	Jan. 12	Jan. 19		Jan. 12	Jan. 19
American Tel. & Tel	125	125¾	Western Tel. & Tel. pfd.	79	79⅛
Cumberland Telephone	*110¾	*114⅛	Mexican Telephone	1⅜	1¾
Edison Elec. Illum.	233	230	New England Telephone	120	*122
General Electric	173	174	Mass. Elec. Ry.	21	22
Western Tel. & Tel	..	8	Mass. Elec. Ry. pfd.	75¾	79

PHILADELPHIA.

	Jan. 12	Jan. 19		Jan. 12	Jan. 19
American Railways	*44	43	Phila. Traction	97⅝	..
Elec. Storage Battery	56	56	Phila. Electric	6⅜	6⅜
Elec. Storage Battery pfd.	56	56	Phila. Rapid Trans.	8¾	8⅞
Elec. Co. of America.	8⅜	8⅛			

CHICAGO.

	Jan. 12	Jan. 19		Jan. 12	Jan. 19
Central Union Tel.	..	..	National Carbon pfd.	92	93¾
Chicago Edison	148⅛	..	Metropolitan Elev. com.	17	16
Chicago City Ry.	162	160	Union Traction	6	6¼
Chicago Tel. Co.	125	..	Union Traction pfd.	30⅛	30
National Carbon	24	26			

*Asked

DIVIDENDS.—The directors of the American Light & Traction Company have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable February 1. The directors of Allis-Chalmers have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock. National Steel & Wire Company directors have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable February 3. The Chicago Edison Company has declared a quarterly dividend of 2 per cent., payable February 1, to holders of record January 23. The Central District & Printing Telegraph (Bell Telephone) Company has declared the regular quarterly dividend of 2 per cent., payable January 30. Electric Company of America directors have declared a dividend of 3 per cent. (30 cents per share), payable January 30. The Columbus (Ohio) Gaslight & Heating Company has declared a dividend of 4 per cent. on its common stock. The Minneapolis General Electric Company has declared a dividend of $3 per share.

THE "SOO" EDISON COMPANY.—Some important changes are to be noted in the personnel of the Edison Sault Electric Company, of Sault Ste. Marie, Mich. At the adjourned annual meeting held January 15, 1904, the following directors were elected: William Chandler, Sault Ste. Marie, Mich.; Henry W. Darling, Schenectady, N. Y.; Alex. Dow, Detroit, Mich.; Alfred Jeretzki, New York; Frank P. Sullivan, Sault Ste. Marie, Mich. The directors elected Mr. Alex. Dow as president and Mr. William Chandler as vice-president. Messrs. Dow, Jeretzki and Sullivan are new names on the board and represent a change of control of the property. Mr. Dow is to be the active representative of the new interests. Mr. Dow is widely known as a manager of other successful illuminating properties, more particularly the Edison system in Detroit. The stockholders at the same meeting authorized the increase of the capital stock of the company from $57,000 to $150,000.

CLARK WIRELESS TELEGRAPH.—At the meeting held last week, the following officers were elected for the coming year of the Thomas E. Clark Wireless Telegraph-Telephone Company: Thomas E. Clark, president, Detroit; Frank Ford, vice-president, Birmingham, Mich.; J. E. Sawyer, secretary, Pontiac, Mich.; Joshua Hill, treasurer, Pontiac; Wm. Barringer, assistant secretary, Pontiac; John Z. Hayes, director, Detroit; A. Stiling, director, Detroit. The further sale of treasury stock was voted upon, and it was agreed that $20,000 worth of the treasury stock should be sold, to increase working capital in order to care for the larger business which was coming to the company in the various lines of wireless telegraph instruments, as well as other electrical specialties.

STORAGE BATTERY OUTLOOK.—Advices from Philadelphia say: "An Electric Storage Battery director says the 1903 year's earnings ran about $4,000,000, the largest business the company ever did. Easily 10 per cent. can be shown earned on the stock. While, as a matter of fact, the company could have paid spot cash for the factory real estate it recently purchased, it was deemed best to accept other terms, because of easy payments with low interest rates."

AMERICAN GRAPHOPHONE.—The American Graphophone Company reports total income for the year of $659,513, and net of $270,266, out of which the preferred dividend takes $78,677, leaving a surplus of $191,589. Assets are put at $3,798,215 and liabilities offsetting, with surplus of $522,403.

SOUTHERN NEW ENGLAND BELL.—It is stated in New Haven dispatches that the directors of the Southern New England Telephone Company have voted to increase the capital stock from $3,500,000 to $4,000,000.

BOSTON EDISON EXTENSION.—The Edison Electric Illuminating Company, it is stated in Boston dispatches, has acquired the Somerville (Mass.) Electric Light Company, the consideration being $577,000.

Commercial Intelligence.

THE WEEK IN TRADE.—Spring trade shows signs of activity, and this, coupled with a large volume of clearance sales by retailers, gives evidence of brisk mid-winter operations. There is also an evident improvement in the industrial situation, particularly in iron and steel mill resumptions, and an active spring is looked for in this line. Reports from all sections of the country are favorable, and trade in all lines of commodities and products is cheerful and satisfactory. Foreign trade returns are gratifying. Export trade in 1903 swelled largely by the record-breaking value of cotton shipments, and aided also by large exports of beef cattle and expansion in exports of manufactured goods, broke all records, exceeding those of 1900 by a small percentage. Imports, too, were the largest on record, the result being a total foreign trade of $2,500,000,000, a sum exceeding all previous totals. The iron trade was irregular, but the outlook and conditions are regarded with favor. Production was the lowest for the past five years, although current resumptions will soon swell the output slightly. Finished products are also irregular. A sale of 20,000 tons of rails for Turkey is reported. Copper, lead and tin are all higher on reported good demand. In copper there was a strong effort to lift the market which resulted in higher quotations. There was little business, however. The closing quotations were 12¾c. for Lake, 12⅝c. for electrolytic and 12½c. for casting stock. There were 315 business failures during the week ending January 14, according to *Bradstreet's*, against 262 the week previous, and 234 the corresponding week last year.

ENGINE OUTLOOK.—An official of the Allis-Chalmers Company is quoted in Chicago as follows: "There has been a great deal of keen competition among builders of machinery during the last five or six months, and the new year has by no means eliminated the condition. Compared with a year ago prices are very much lower, and the volume of business available shows marked shrinkage in many lines, particularly that of heavy power engines such as are used by the public service companies of municipal corporations. These projects are very nearly all dependent upon the flotation of bonds and at the prevailing high rates for money it is practically impossible to carry out such plans. There are many projects planned, but held in abeyance because of these conditions. This company is

getting its share of the business offering and our principal orders now are coming from the southwest, where milling and mining machinery is in fair demand. Old Mexico is also taking more modern machinery than usual. Outside of Mexico, and some work in the Canadian border country, export business is slack. In continental Europe there is very little demand for American machinery at this time, the disposition being inclined to discriminate against it, especially in Great Britain and Germany. South Africa is a good field, but it does not seem to recuperate as rapidly as it should since the Boer war. The great complaint there is the scarcity of labor. Capital is not doing much in the South American republics on account of the almost incessant political uprisings in those countries."

ELECTRIC LIGHT ENGINE WANTED.—The electric light company of Teneriffe, Canary Islands, is desirous of purchasing an American electric light engine of at least 500 hp, as with the machinery they now have they find it impossible to meet the large and constantly-increasing demand for electric light. The engine required must be of the latest pattern, of first-class material, and up-to-date in all respects. Price should be quoted c.i.f. Teneriffe. The following firms issue through bills of lading at Teneriffe: Elder, Dempster & Co., Produce Exchange, New York, and J. M. Ceballos & Co., Wall Street, New York. Quotations and all communications should be addressed to Senor Don Nicolas Marti, presidente Compania Electrica e Industrial, Teneriffe. The above information is from Mr. Sol. Berliner, United States Consul at Teneriffe, Canary Islands, South Atlantic.

SOME BUFFALO FORGE COMPANY ORDERS.—The Buffalo Forge Company reports through its New York offices in the Taylor Building that business in their lines is picking up considerably and that several interesting engines are on hand. The De Witt Wire Cloth Company, De Witt, N. J., is extending its factory and has ordered a horizontal center-crank Buffalo engine of 40-hp capacity for direct connection to a 25-kw Crocker-Wheeler generator. The Newberger Electric Company, of Brooklyn, has ordered a 100-hp horizontal center-crank Buffalo engine for direct connection to a 60-kw Elwell-Parker motor. This outfit is intended for lighting purposes. The Mackay Engineering Company, Singer Building, New York, has requisitioned for a 25-hp vertical engine for direct connection to a 15-kw Akron generator for lighting the Mutual Chemical Company's plant.

FOREIGN TRADE FIGURES.—The month of December shows up well with imports of $77,750,284 and exports of $174,734,368, giving an excess of exports of $96,984,084, the largest excess for any month last year. The total exports excess for the year was $489,122,029, which has only been exceeded in three years since 1892, while the total of exports, $1,484,854,694, is the largest for any year in that long period, and the total import and export trade is also nearly $150,000,000 more than the previous largest year, 1901, being not less than the magnificent figure of $2,480,587,359. This does not look very much like adversity, and there is in it no justification for the shallow pessimism of last year. Moreover, against the highest exports of the year in December, the imports for the same month were the lowest, which does not look like extravagant indulgence in foreign luxuries.

EQUIPMENT FOR NEW LEHIGH VALLEY RAILROAD SHOPS.—Contracts have been let for the equipment of the locomotive shops now under construction at Sayre, Pa., by the Lehigh Valley Railroad Company. The capacity of the power plant will be 8,000 hp. The Westinghouse Electric & Manufacturing Company secured the contract for the generating equipment. McIntosh, Seymour & Co. will build the engines. Wickes Brothers, Saginaw, Mich., have taken the contract for the boilers. The crane equipment will be installed by the Shaw Electric Crane Company, of Muskegon, Mich. There will be twelve cranes. The contract for the ventilating equipment has been let to the Buffalo Forge Company. Ten 10-ft. fans will be installed in the main locomotive shops, each fan driven by 20-hp motors, which have yet to be ordered.

HOLTZER-CABOT PRESS MOTORS.—The American Type Founders Company, of Jersey City, has awarded a contract to the Holtzer-Cabot Electric Company, New York offices 43 Liberty Street, for a number of special designed motors which are to be used for driving the company's catalogue printing presses. Thirteen motors have already been ordered. They will have varying speeds and will be of from ¼ hp to 5 hp capacity. The motors will be fitted with either Carpenter or Cutler-Hammer control. They will be placed under the step of the printing presses. The presses will be built by the Whitlock Company, Derby, Conn. Motors will also drive the servers and cutters.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, of Chicago, reports a steady demand for its various types of switchboards and telephones, its new type mechanical self-restoring drop board meeting with special favor. Among recent shipments might be mentioned the following: Nappanee, Ind., 300 capacity; Bevier, Mo., a 100-capacity addition to the first section installed within the past thirty days; Bunker Hill, Mo., 100-capacity; South Wayne, Wis., 100-capacity; Gratiot, Wis., 100-capacity; Chatham, Ill., 150-capacity; Divernon, Ill., 150-capacity; Winslow, Ill., 100-capacity. A number of the above orders included complete telephone equipment as well.

BROOKLYN HARDWARE FACTORY.—Percival Robert Moses, 35 Nassau Street, New York, has let contracts for the equipment of the large hardware factory which is being built at Kent Avenue and South Eighth Street, Brooklyn, for Charles R. Ring. The power equipment will have a capacity of 150 hp. The engine, a belted one, will be of Fitchburg build. The boilers, two units, have been ordered from the Bigelow Company, 15 Cortlandt Street, New York. The generator will be of C. & C. make. Its capacity will be 65 kw. A combination passenger and freight elevator will be put in by the A. B. See Elevator Company. Several motors have yet to be ordered.

THE PROMETHEUS ELECTRIC COMPANY, 39 Cortlandt Street, New York, manufacturers of electric heating and cooking apparatus, elected the following officers at its annual meeting: President, David T. Davis; vice-president, Dr. S. S. Wheeler; treasurer, William B. Symmes, Jr.; secretary, Max Loewenthal. The above gentlemen, in conjunction with Mr. Max Osterberg and Mr. William Ballin, constitute the board of directors. The outlook for the sale of the apparatus is reported as excellent, and the sales during the past year have been very encouraging.

TRAIN LIGHTING.—At a meeting of the board of directors of the Consolidated Railway Electric Lighting & Equipment Company, held January 13, Col. John T. Dickinson, heretofore general agent, was elected second vice-president in charge of negotiations with railway companies for the use of the Consolidated "Axle Light" system of electric car lighting. The company's general offices were recently moved from 100 Broadway to the Hanover Bank Building, corner Pine and Nassau Streets, New York City.

THE WESTERN ELECTRIC COMPANY reports having received orders for 250 fire alarm boxes and complete central station equipment for the World's Fair at St. Louis. The apparatus will be similar to that used in the city of Chicago. As a result of the recent fire in the latter city, all the theatres and many of the large business houses are being supplied with Western Electric fire alarm boxes, which will be connected direct with the city system.

EQUIPMENT FOR ARGENTINA FORTIFICATIONS.—The government of the Argentine Republic is to purchase considerable electrical equipment for installation in the fortification works of the Puerto Militar. About $25,000 gold will be expended. The equipments will include machinery for the manipulation of disappearing guns, ammunition hoists, deck winches, portable stationary blowers, etc.

3,000 HP MORE FOR SAO PAULO COMPANY.—The additional equipment to be installed in the Rio Tiete hydraulic plant operated by the Sao Paulo Tramway, Light & Power Company, of Sao Paulo, Brazil, will be of 3,000-hp capacity. The existing plant is of 7,000 hp. The contracts for the new installation will be let through the New York offices of the concern, 29 Broadway, early next month.

STEEL TOWERS FOR MEXICAN TRANSMISSION LINES.—The Mexican Light & Power Company, New York offices 29 Broadway, is in the market for about 2,000 steel towers of special design which are to be used for carrying the transmission lines which are to run between the Necaxa plant of the company to Mexico City, and to El Oro mining district, a total distance of about 150 miles.

THE HERTNER ELECTRIC COMPANY, of Cleveland, Ohio, has just completed the installation of 30 motors in the large printing establishment of Martin & Lamb, of that city. Every press, cutter, folder and stitcher, as well as all the separate tools used in the binding and electrotyping departments, are operated by individual motors specially designed.

PUMPS FOR WORLD'S FAIR.—The Warren Steam Pump Works, of Warren, Mass., have secured the contract for the pumping equipment to be installed in the 5,000-hp plant which is to operate the Intramural Electric Railway in the St. Louis World's Fair grounds.

THE MANSFIELD ENGINEERING COMPANY, of Mansfield, Ohio, is building three 200-hp engines, which will be used in driving part of the electrical equipment at the St. Louis World's Fair.

BALL ENGINE ORDER.—The Union Ice Company, of Bakersfield, Cal., has recently purchased a 300-hp Ball automatic engine from the Ball Engine Company, Erie, Pa.

THE OSBORN ENGINEERING COMPANY is preparing plans for a large plant to be erected at Clarksburg, W. Va., for the National Carbon Company, of Cleveland.

General News.

THE TELEPHONE.

EVENING SHADE, ARK.—The Sharpe County Telephone Company has been incorporated with a capital stock of $1000. C. J. Wilson is president.

LOS ANGELES, CAL.—The Monrovia Telephone & Telegraph Company has created a bonded indebtedness of $25,000.

LOS ANGELES, CAL.—The Imperial Telephone Company is making an extension of its line from Imperial to Holton.

LOS ANGELES, CAL.—The Home Telephone Company has petitioned the City Trustees of Fullerton to advertise for sale a telephone franchise in that city, promising to begin work at once and spend $4000 in two years.

LOS ANGELES, CAL.—Increase in business has made it necessary for the Sunset Telephone Company to construct a new line from San Diego to Corona, a distance of about 100 miles. The new line has been completed to Pala, 45 miles south of Corona.

LOS ANGELES, CAL.—The rumor to the effect that there is to be a merger of the Home Telephone Company with the Sunset Company is denied. At the present time, the Home concern has about 11,000 telephones working and nearly as many contracts yet to fill, according to General Manager Van Liew. Furthermore, there are about twenty-five long-distance toll lines connected through, and, in addition to this, all towns in Southern California of 5000 population and over have been connected-up locally. Mr. Van Liew says that he has not had a solicitor out for almost a year, and that contracts are being signed faster than is possible to meet them.

BOISE, IDAHO.—Articles of incorporation of the Independent Long Distance Telephone Company have been filed here. The capital stock is $250,000 and the principal office of the company is to be in this city. The directors are H. E. Neal, E. H. Beggs and A. J. Swain, of Boise; James McDevitt, R. E. Shaw, Harry L. Fisher, C. J. Sinsel and M. B. Zimmer.

DANVILLE, ILL.—The Vermillion County Telephone Company has increased its capital stock from $150,000 to $400,000.

ADRIAN, ILL.—The Carthage & Coluca Telephone Company has been incorporated with a capital stock of $2500. The directors are William Black, J. L. Haines and others.

JACKSONVILLE, ILL.—Representatives of thirteen independent telephone companies in central and western Illinois met at this place Jan. 5, for the purpose of organizing an independent telephone association and of arranging matters so that it will be clearly understood what part of the gross charge each company is to receive for the transmission of a long-distance message, or of messages other than local. It is expected that during the present year they will establish copper metallic circuits between Hannibal, Springfield, Alton, Louisiana, Jacksonville and other cities of importance in the district embraced by the following counties, which were represented in the meeting: Calhoun, Jersey, Macoupin, Green, Scott, Morgan, Cass, Sangamon, Pike, Adams, Browne, Hancock and Hannibal and several counties in Missouri.

SOUTH BEND, IND.—The Central Union Telephone Company will rebuild its plant during the spring, placing the wires underground.

OAKLANDON, IND.—The Rural Telephone Company, of this place, has been organized with a capital of $300. The directors are Michael Mock, Henry Mock and John W. Apple.

MUNCIE, IND.—The Delaware & Madison Counties Telephone Company reports having had a very successful year. The company is now operating over a large territory and has 3100 telephones in service. The company has expended over $80,000 in extensions during the past year.

DANVILLE, IND.—One hundred and thirty-eight farmer patrons of the Consolidated Telephone Company of this city and community are at outs with the management and threaten to organize a company and establish a system of their own. The company has recently consolidated the exchanges in Danville, Plainfield, New Salem and Pittsboro and put in new metallic service greatly improving and extending the service. The management announced that after Dec. 31, the rate for residence and country telephones would be $1 a month, an increase of 25 cents. The farmer patrons rebelled and held a mass meeting and passed resolutions to the effect that they would retain their telephones at the old price, but in case service was denied them they would establish their own system. However, after investigating the cost of a new plant and realizing its limitation, some of the more conservative farmers are inclined to remain with the company. It is asserted that Bell people are backing the farmers and have looked with favor on this territory for some time. The Bell Company has only a pay station in Danville.

EXLINE, IA.—The Exline Telephone Company has ordered 1300 lbs. of wire to build a new line.

VALLEY JUNCTION, IA.—The Grimes Mutual Telephone Company has been granted a local franchise.

REINBECK, IA.—The Reinbeck Mutual Telephone Company has been organized to establish a local mutual exchange.

BUFFALO CENTER, IA.—Another rural telephone line will be built south and east of Buffalo Center by the Great Northern Telephone Company.

JEFFERSON, IA.—The Citizens' Mutual Telephone Company, of Jefferson, has been incorporated. Capital stock, $9990. Incorporators: J. E. Shaw and several others.

VALLEY JUNCTION, IA.—The Valley Junction & Orilla Telephone Company has been organized and will build a line in the spring. F. L. Bailey, of Bloomfield township, is secretary.

DETROIT, KAN.—A farmers' mutual telephone company is being organized by farmers south of Detroit.

MONTGOMERY, MASS.—The New England Telephone & Telegraph Company will build a line from Russell to Montgomery.

ESCANABA, MICH.—The Finch Telephone Company will extend its line to Menominee.

HILLSDALE, MICH.—Extensive improvements to cost in the neighborhood of $8000, are about to be made by the Bell Telephone Company in its Hillsdale plant. The cables are to be extended, the switchboard and operating room enlarged and provision made to accommodate 200 additional subscribers.

PILLAGER, MINN.—E. P. Bacon proposes to establish a telephone exchange in this place.

DASSELL, MINN.—A telephone line is to be constructed to Lake Jennie. Work will be started in the early spring.

COMFREY, MINN.—The North Star Telephone Company contemplates building a line from Comfrey to Springfield.

BLACKDUCK, MINN.—The Blackduck Electric & Telephone Company will be incorporated with $25,000 to $50,000 capital stock.

ST. PAUL, MINN.—The Nicollet County Telephone & Telegraph Company has increased its capital stock from $20,000 to $50,000.

COMSTOCK, MINN.—The Neightborhood State Telephone Company has been incorporated with a capital stock of $25,000. The directors are H. H. Harvey, Sam Gilbert and others.

ABBOTTSFORD, MISS.—The Abbottsford Electric Light & Telephone Company, Abbottsford, Clarke County, has been incorporated; capital stock $25,000. A. J. Young, E. C. Schilling and G. H. Schilling are the incorporators.

SEDALIA, MO.—The Missouri and Kansas Telephone linemen here struck Jan. 2, because their wages had not been increased from $2.25 to $2.50 a day, with one and one-half pay for overtime and double pay for Sundays. The men went to work on the promise that the matter would be considered upon the return of President Burt from Boston, but nothing having been done, they struck again Jan. 6.

BASSETT, NEB.—The Bassett-Springview Telephone Company has increased its capital to $25,000.

VINELAND, N. J.—The United Telephone & Telegraph Company, of Vineland, has been incorporated with a capital stock of $25,000, by Joseph H. Dowler, Jr., Walter D. Wilson, Wm. E. Wilson, J. Homer Lewis and Henry Taylor.

PLAINFIELD, N. J.—The public services committee of the Common Council has recommended that the application for a franchise by the Central New Jersey Telephone Company be refused. In the committee's opinion the time is not ripe for the granting of another license.

SENECA FALLS, N. Y.—The Home Telephone Company is about to extend its line from Waterloo to Geneva.

WHITESBORO, N. Y.—The Central New York Telephone & Telegraph Company and the Utica Home Telephone Company have made application for franchises in the village.

NORTH WALCOTT, N. Y.—The North Walcott Telephone Company has been incorporated with a capital stock of $5500, by D. J. Kyle, N. F. Fields, and George W. Van Note.

PLATTSBURGH, N. Y.—The Beekmantown Telephone Company, of Plattsburgh, N. Y., has been incorporated; capital, $1000. Incorporators: Chellis Brothers, Addison Ladd, Nathan R. Mason, all of Plattsburgh, N. Y.

RICHFIELD SPRINGS, N. Y.—The Winfield Home Telephone Company, Richfield Springs, has been incorporated; capital, $5000. Incorporators: Frederick C. Ward, Cooperstown; Willard Bullion, George Cany, Richfield Springs.

JAMAICA, L. I., N. Y.—The New York & Long Island Telephone Company is strongly competing with the New York & New Jersey Telephone Company in this section. The new company is offering all sorts of inducements to subscribers. The New York & New Jersey Company has as yet made no effort to meet the competition.

QUAKER CITY, OHIO.—The Yoker Valley Telephone Company has been incorporated with a capital stock of $550. Directors: W. W. James, N. P. Hartley and others.

CHATTANOOGA, TENN.—After a long fight over the question of a charter for an independent telephone company in Chattanooga, the matter has been settled by the signing of a contract by the East Tennessee and Hamilton Telephone Companies, fixing the charges in the city and suburbs by specifying the rates to be charged within prescribed limits.

MIDLAND, TEX.—The Automatic Telephone Company has been incorporated with a capital stock of $10,000. Directors: E. H. Estes, J. T. Blair and others.

BEAUMONT, TEX.—The Southwestern Telegraph & Telephone Company will erect an office and exchange building here. J. E. Farnsworth, general manager, Dallas, Texas, can give information.

SMITHVILLE, TEX.—The Smithville Telephone Company, of this place, has purchased the telephone line of the Smithville & Red Rock Telephone Company and will extend it to Lockhart.

PETERSBURG, VA.—The Petersburg Telephone Company is extending its line from DeWitt to McKenney Station in Dinwiddie County.

PORT ROYAL, VA.—The Royal Telephone Company, of this place, has been chartered with a capital stock of $3000 to $5000. Mr. George W. Forsyth is secretary and treasurer.

CHEHALIS, WASH.—A telephone company is projected to build a line to Aberdeen.

CENTRALIA, WASH.—The Sunset Telephone Company will build a line from this city to Elma, 30 miles.

EVERETT, WASH.—The Skagit Farmers' Mutual Telephone Company will ask for a franchise for an independent telephone system.

READSTOWN, WIS.—The Readstown Telephone Company of the village of Readstown, Vernon County; capital $5000, has been incorporated by F. M. Groves, G. W. Heinka, C. A. Reeve and G. A. Ewers.

ELECTRIC LIGHT AND POWER.

TEMPE, ARIZ.—The Tempe Canal Company will probably construct a power plant to cost $170,000. G. Jones, J. Woolf and Carl Hayden, all of Tempe, are among the stockholders.

ALHAMBRA, CAL.—Bids are wanted Feb. 9 for a franchise for furnishing electricity for light, heat and power. A. A. Clapp, Sr., is City Clerk.

LOS ANGELES, CAL.—A company has been organized at Downey to build an electric light plant. The incorporators are Dr. Q. J. Rowley, A. L. Ball, T. R. Crawford, Joseph Smith and S. S. Skidmore.

LOS ANGELES, CAL.—John B. Miller, president of the Edison Electric Company, speaking of the company's plans, says: "The first power line in the vicinity of Santa Barbara will be a branch line from the 60,000-volt transmission line, to connect with the 28,000-hp plant we are building at the mouth of Kern River, but this plant will not be completed for about 18 months. We expect, however, to complete a 1000-hp plant on Lytle Creek some time in February or March, and another plant of 2000-hp capacity on the Santa Ana River, immediately below our 4000-hp plant on that river, some time next summer. Both of these plants will be connected with our main transmission line running from Santa Ana River and Mill Creek, back of Redlands, to Los Angeles, and will represent an expenditure of about $350,000."

SOUTH GLASTONBURY, CONN.—Engineers Daboll & Crandall, of New London, are preparing an estimate of the available power and cost of development of Roaring Brook.

SANDERSVILLE, GA.—Bids are wanted Jan. 27 for constructing water works and an electric light plant.

ALBANY, GA.—The city of Albany has agreed to take 300 electrical horsepower for lighting the city and supplying power at the water plant, from the Florida capitalists who have in hand the proposed development of Big Shoals on Muckafoonee creek. It is proposed to develop from 15,000 to 25,000 horsepower.

ATLANTA, GA.—Park Woodward, general manager Water Works Department, in his annual message recommends an electric light plant for No. 2 pumping station, the filter house and the old and new reservoirs, at a cost of $5000.

HAILEY, IDA.—R. J. Allen, of this city, is promoter of an enterprise to build a power plant here at a cost of about $50,000.

MOLINE, ILL.—The People's Power Company will purchase two water-tube boilers and one 250-hp engine.

PEORIA, ILL.—The Peoria Gas Light & Coke Company has been bought by the Peoria Gas & Electric Company. The capital stock has been increased from $2,000,000 to $2,500,000.

TAMMS, ILL.—The Illinois Milling & Elevating Company has been incorporated, with a capital of $50,000. It will furnish electric light and power. The incorporators are Oscar T. Tamm, Joseph Mayer, Jr., David S. Lansden.

MONTPELIER, IND.—The city is considering the question of constructing an electric light plant.

NORWAY, IND.—A. A. McKain, of this place, and others, of Indianapolis, have purchased the power dam in Tippecanoe River, and will at once establish an electric power plant.

SOUTH BEND, IND.—The South Bend Electric Company is preparing to place its wires underground, and arranging for the new lighting system, which will require about 450 enclosed arc lights. F. A. Bryan is general manager.

VINCENNES, IND.—The City Council has granted P. K. Tyng an extended franchise of 25 years for his electric light plant and service. Mr. Tyng is to furnish free lights to the city hall, the city to pay for all fixtures and breakages after once placed.

MONTICELLO, IND.—A. A. McKam and others, of Indianapolis, have purchased the water power dams at Norway and Tioga, on the Tippecanoe River near here and will at once improve them for the purpose of erecting electrical power plants. The promoters propose furnishing electricity to the surrounding towns and cities.

CRESTON, IA.—M. E. Springer, of Des Moines, is interested in the construction of an electric light and gas plant for Creston.

BAXTER SPRINGS, KAN.—It is stated that the deal for the transfer of water rights at Baxter Springs from the city to W. G. Sergeant, of Joplin, Mo., has been closed. He proposes commencing work in the spring. The power house will be constructed at Lowell.

PORTLAND, ME.—The North Shore Power Company has been incorporated to supply electricity for light, heat and power; capital, $500,000. C. C. Le Grow and E. E. Stone, both of Portland, and H. E. Stevens, Boston, Mass., are among the directors.

WARE, MASS.—The Ware Electric Company has petitioned the State Board of Gas and Electric Light Commissioners at Boston for authority to issue additional capital to the amount of $10,000 for the purpose of extending the plant.

HOLYOKE, MASS.—According to the annual report of the Gas and Electric Department of Holyoke, the equipment of the electric light station which was transferred to the city less than one year ago was at that time obsolete and overloaded. The poles were decayed and the wire insulation badly impaired, and all overloaded. It has been decided to discard all of the present electrical machinery and substitute for the small units two large ones that will develop electrically and economically all of the power furnished by the water wheels. It is also planned to change the entire street lighting service to enclosed arcs and add 236 lights to the 263 at present in use, making a total of 499 street lamps.

BUFFALO, N. Y.—The electrical workers of this city are on a strike because the contractors decided to keep "open shop."

SCHENECTADY, N. Y.—The Schenectady Railway Company secured the contract for lighting the city for three years at 22½ cts. per lamp per night.

CAMDEN, N. Y.—The citizens voted Dec. 29 to issue $40,000 bonds for the establishment of a municipal electric light plant. H. B. Sweet, of Utica, is engineer. H. G. DuBois is president of the Council.

ONEIDA, N. Y.—It is stated that arrangements have been made by the Madison County Gas & Electric Company to acquire the Lime Kiln Falls electric water power plant. Mr. DeWitt C. Haddock will complete the Falls plant and have it ready by July 1 next. The plant will have a capacity of 1500 horsepower and will cost about $130,000.

WINSTON, N. C.—W. T. Brown and others have been appointed a committee to investigate the feasibility of an electric lighting plant in this city.

ATTICA, OHIO.—An election has resulted in favor of issuing $6250 in bonds for the purpose of building a municipal lighting plant.

TOLEDO, OHIO.—The Hocking Valley Railway Company will spend $50,000 in installing a power plant and equipping all its machinery on its coal and ore docks here with electricity in place of steam.

XENIA, OHIO.—Charles Darlington, M. D. Stewart and others are planning to organize a co-operate electric light company. The capital stock will be $30,000. The company will erect a lighting plant and furnish current for commercial and private use.

KENTON, OHIO.—The Kenton Ice Company will erect an artificial ice plant and install considerable electrical equipment. The York Manufacturing Company, of York, Pa., is supplying plans for the plant. W. P. Bowman is manager of the Kenton Company.

ELYRIA, OHIO.—The Ely Realty Company is erecting an addition to its power plant and will install a 300-hp gas engine direct-connected to a Westinghouse alternating current generator. A rotary converter will be installed for supplying direct current to a portion of the system.

MASSILLON, OHIO.—At the recent meeting of stock holders of the Massillon Light, Heat & Power Company, directors were elected and they, in turn, elected officers as follows: President and treasurer, Warren E. Russell; vice-president, Joseph K. Russell; secretary, Maurice R. Bissell.

SHERIDAN, ORE.—The Yamhill Milling Company, of Sheridan, is considering the installation of an electric light plant for its mill, and also for lighting the town.

ROSEBURG, ORE.—The plants of the Douglas Electric and Water Company, of this city, and the Roseburg Water & Light Company, of Winchester, have been purchased by the Oregon Boom & Timber Company, the consideration being $125,000 for the Winchester plant and $50,000 for the Roseburg holdings.

BRADDOCK, PA.—An ordinance has been submitted to Council providing for an issue of $20,000 bonds for a municipal electric light plant.

GETTYSBURG, PA.—The Council has authorized the Light Commission to procure an estimate of cost of constructing and operating a municipal electric light plant.

HARRISBURG, PA.—According to a report made by Prof. Jackson, of the State College, the Harrisburg Light, Heat & Power Company is supplying not more than one-half the light required by the contract with the city. The investigation was made at the instance of Mayor McCormick.

SARATOGA, TEX.—The Sour Lake Electric Light & Power Company, of Sour Lake, will install an electric light and power plant at this place.

SALT LAKE CITY, UTAH.—A deal which creates an electrical monopoly in the state was consummated in the merger of the Utah Light & Power Company and Consolidated Railway & Power Company under the name of the Utah Light & Railway Company. The new corporation is capitalized for $10,000,000. Joseph F. Smith was selected president of the company and the former manager of the Utah Light & Power Company, R. S. Campbell, will be secretary and general manager. Extensive improvements will be commenced at once, and the directors have in view the outlay of about $1,000,000 in the next few years in repairs and improvements. Of the total capitalization $4,000,000 will be held for sale for the improvement of the plant and system.

WISE, VA.—The Cumberland Light & Transportation Company has been organized at Wise, by E. M. Fulton, H. M. Smyth, G. A. Esser and others to build an electric railway from Wise, connecting the mining towns of Norton, Glamorgan, Dorchester, Coeburn, Big Stone Gap and Stonega. Bids for construction will be received till Jan. 15. Address, E. M. Fulton, of Wise.

EVERETT, WASH.—It is reported that J. T. McChesney will expend about $500,000 in developing the falls near Wallace on May Creek.

SHELTON, WASH.—W. H. Kneeland has purchased the Shelton electric light plant and proposed increasing it and improving the service.

MOUNDSVILLE, W. VA.—The Council has granted a franchise to the Moundsville Electrical Company.

SHAWANO, WIS.—The citizens have voted to issue bonds for enlarging the electric light plant.

ANTIGO, WIS.—A charter has been granted to the Antigo Light, Heat & Power Company, of Antigo; capital, $50,000. Incorporators: W. L. Elliott, C. T. Mortensen and F. C. Duchac.

OTTAWA, ONT.—The ratepayers of the city of Ottawa have voted by a large majority to adopt a by-law providing $50,000 for the establishment and operation by the municipality of an electric lighting plant for street lighting purposes.

MONTREAL, QUE.—Engineer J. Phelps, of Baltimore, Md., has submitted his report to Council on the cost to the city of a modern conduit system. There is an estimate on four classes of conduits to be known as Classes A, B, C and D. According to Class C, which he recommends for Montreal, the cost per duct foot is 37.24 cts.; the main conduit to cost $1,005,750, and the distributing system $199,100. According to Class A, the cost per duct foot is 45.9 cts.; Class B, 43.34 cts., and Class D, 34.68 cts.

THE ELECTRIC RAILWAY.

OPELIKA, ALA.—Rush Taylor has secured a franchise to build an electric railway from Opelika to Auburn. The road will be known as the Opelika Electric Street and Interurabn Electric Railway.

SAN FRANCISCO, CAL.—The shareholders of the Petaluma & Santa Rosa (Electric) Railway will meet in San Francisco, on Feb. 9, to authorize a mortgage to the Mercantile Trust Company, of San Francisco, to secure an issue of $1,000,000 of 5 per cent 20-year gold bonds, to be dated March 1, 1903, and to be subject to call on six months' notice at 110. Of the bonds, $500,000 will be reserved for extensions. E. H. Rollins & Sons, the bankers, have arranged to finance the enterprise. The company was incorporated on June 20, 1903, with $1,000,000 authorized capital stock, to build 32 miles of electric railway between Petaluma, Sebastapool, Santa Rosa and Forestville. There will be steamer connection between San Francisco and Petaluma. The officers and directors are John A. McNear, president; W. F. Kelly, vice-president; Burke Corbet, treasurer; Thomas Archer, secretary; Francis Cutting, of the Cutting Company; W. F. Kelly, of the Oakland Transit Company; Thomas Archer, of the E. H. Rollins & Sons, of Boston; John A. McNear, Burke Corbet, W. H. Pope and F. A. Brush, of the Santa Rosa National Bank, directors.

CHICAGO, ILL.—The Metropolitan West Side Elevated Railroad Company has made application to list $7,500,000 common stock on the New York Stock Exchange.

TAYLORVILLE, ILL.—David M. Sharp, of Taylorville, has applied to the Secretary of State for articles of incorporation for an interurban railway system in this county. The company will be capitalized at $205,000.

CHICAGO, ILL.—The Springfield & Peoria Railway has been incorporated with a capital of $50,000. Incorporators and first board of directors: Francis S. Peabody, John J. Hart, Arthur W. Underwood, Frederick W. Upham, all of Chicago, Ill.

PEORIA, ILL.—The Peoria & Rock Island Traction Company has been incorporated; capital $100,000. Incorporators and first board of directors: W. B. McKinley, Charles Zilly, B. R. Stephens, B. E. Cartwright and J. E. Barry, all of Champaign, Ill.

MENDOTA, ILL.—The Northern Illinois Traction Company has been incorporated with a capital of $25,000. The incorporators and first board of directors are Hal B. Allen, Erie, Ill.; W. A. Burkley, Mendota, Ill.; George W. Hamilton, Means A. Booth and W. E. Booth, New Bedford, Ill.

NATICK, MASS.—The Natick & Needham Street Railway has gone into the hands of N. Summer Myrick as receiver on the petition of its stockholders. The petition for the appointment of a receiver was the outcome of the refusal of the receiver appointed for the South Middlesex Street Railway, to which the Natick & Needham Street Railway was leased, to operate the latter line. It is said that the Natick & Needham will now surrender its charter; that the road will be dug up, and that the rails and rolling stock will be disposed of at the best price they will bring.

BROOKLYN, N. Y.—The Appellate Division of the Supreme Court, in Brooklyn, has handed down a decision sustaining the city's ordinance requiring street railroad companies to carry passengers from any part of the railroad to their destination at any other part of the same railroad without a change of cars.

GLOVERSVILLE, N. Y.—The Fonda, Johnstown & Gloversville Railroad Company has purchased the property of the Adirondacks Lakes Traction Company, consisting of the electric railway leading from Gloversville to Mountain Lake, and all the hotels, pavilions and other property at the lake. The road will be run independently of the Fonda, Johnstown & Gloversville system. The following officers have been elected: John Shanahan, president; Lyman K. Brown, vice-president; E. H. Steckel, secretary.

NEW YORK, N. Y.—Supreme Court Justice Fitzgerald, of White Plains, has granted an order allowing the Interurban Street Railway Company to assume the new name of "New York City Railway Company" on and after Feb. 10 next. The petition of the company asking for the change says: "At the present time there are several corporations operating in the same district, which results in confusion tending to prejudice its interests, and the name it desires to adopt will better indicate the nature and extent of its system, which comprises practically the entire surface street railway system in New York City."

CHARLOTTE, N. C.—The Goldsboro and Seven Springs Securities Company is a new North Carolina concern which, among other rights, has the privilege of building street car and trolley lines, hotels, roads, etc., capital $150,000.

YORK, PA.—The York County Traction Company, which has been negotiating for the purchase of the Hanover & McSherrystown Street Railway Company and the Hanover Light & Power Company, has consummated the deal, and the two companies will now be merged in one and form one county system covering almost every important point in York County. The consideration was $100,000. The officers of the Hanover & McSherrytown Street Railway Company resigned their positions Dec. 31, and the new officers were elected to take their place as follows: Captain W. H. Lanius, of York, president; Ellis S. Lewis, of York, treasurer; George S. Billmeyer, John W. Steacy, of York; William A. Himes, of New Oxford, Harry N. Gitt, Charles Ehrhart and Thomas J. O'Neall, of Hanover, directors.

WAUWATOSA, WIS.—Mayor E. D. Hoyt and the Common Council of Wauwatosa have filed an answer to the petition of the residents for a writ of mandamus to compel the city authorities to submit the question of railway franchise ordinance to a vote of the people, in which they state that the latter had no right to vote upon the subject. They assert that the ordinance is not a new one and that it seeks to extend existing railway lines and is simply an extension or an amendment of the present ordinance, and therefore does not come within the law enacted by the legislature last spring.

NEW INDUSTRIAL COMPANIES.

THE AMERICAN CAR TELEPHONE COMPANY has been incorporated at Grand Rapids, Mich., with a capital stock of $2,500,000.

THE VACUO-STATIC CARBON COMPANY, of Rochester, N. Y., has been incorporated with a capital stock of $60,000. The directors are P. A. Clum, C. M. Lane and F. J. Cross, Rochester.

THE ECONOMIC ELECTRIC COMPANY, of New York, has been incorporated; capital, $200,000. Directors: L. L. Roberts and Edmund Tweedy, of New York, and William Newcomb, of Tenafly, N. J.

THE ELECTRIC DEVELOPMENT & SECURITIES COMPANY, with a capital stock of $100,000, has been incorporated in New York City. The directors are W. C. Goodale, J. M. O'Laughlin and M. R. O'Laughlin, of New York City.

THE CUMBERLAND ENGINEERING COMPANY has been incorporated at Cleveland, Ohio, with $25,000 capital stock, by W. H. Pelton, A. E. Thompson, E. Shoemaker, E. L. Dulz and N. B. Daerr. The company will do a general contracting business.

THE PRISMATIC ELECTRIC MFG. COMPANY, of New York City, has been incorporated to manufacture prismatic and electrical novelties. The capital stock is $200,000, and the incorporators and directors for the first year are M. E. Wooster, C. E. Bleyer and L. Wallach, of New York City.

THE MOLINE INCANDESCENT LAMP COMPANY has been incorporated at Moline, Ill., by Albert H. Kreitler, C. F. Gantz and E. E. Morgan. The purpose of the company is to manufacture incandescent lamps and other electrical apparatus. The capital stock is $30,000, and the first board of directors is composed of the following-named gentlemen: C. H. Deere, E. E. Morgan, H. W. Cooper, C. P. Skinner, C. R. Wood, Edward Coryn and A. H. Kreitler.

OBITUARY.

MR. W. W. SKILES.—We regret to learn the death on Jan. 9, of Mr. W. W. Skiles, the president of the Shelby Electric Company, of Shelby, Ohio. The funeral took place on Jan. 13.

MR. A. G. NICHOLS.—Mr. Amos G. Nichols, president of the New York Safety Steam Power Company and president of the Langworthy Machine Company, died at Hope Valley, R. I., on Wednesday, Jan. 13, after a short illness. Funeral services were held at Hope Valley on Jan. 16.

MR. A. G. GARRISON.—We learn with deep regret, just at the moment of going to press, the news of the death of Mr. W. O. Garrison, president of the Columbia Incandescent Lamp Company, of St. Louis. This young and talented man has been ill for some time, but this news will come as a severe blow to a wide circle of friends and admirers all over the country.

PERSONAL.

W. T. GENTRY.

MR. W. T. GENTRY.—Vice-president and general manager W. T. Gentry, of the Southern Bell Telephone and Telegraph Company, was given a dinner at the Capital City Club, Atlanta, Ga., on Thursday, January 14, by the officials of the company in commemoration of the twenty-fifth anniversary of his continuous service. Among other prominent officials invited or attending were Mr. Edward J. Hall, president of the company, and vice-president of the American Telephone and Telegraph Company, and Mr. Charles H. Wilson, general superintendent of the latter company and formerly general manager of the Southern Bell Company. The territory under the management of Mr. Gentry embraces seven southern states and the company operates upwards of 40,000 telephones. Mr. Gentry is a man of much energy—democratic in his ways and personally known to almost every employe—and to thousands of business men and officials throughout the seven southern states within the jurisdiction of his company. He is gentle of speech and beneficent of mind—wise to resolve and patient to perform—of the mildest manner and gentlest heart. Mr. Gentry entered business life as a telegraph operator for the Southern Atlantic Telegraph Company in 1870, at Charlottesville, Va., serving the company later at Lynchburg and Richmond, Va., finally receiving the appointment of circuit manager with headquarters at Gormondsville, Va. The Southern Atlantic Company being absorbed in 1876 by the Western Union Telegraph Company, Mr. Gentry was transferred to Wilmington, N. C., at which place in 1879 he built the first telephone exchange, using the Edison patents and apparatus. After three years' service, he was again transferred to the management of the Western Union office at Alexandria, Va., constructing at that place a telephone exchange in the interest of the Southern Bell Telephone and Telegraph Company and managing it in conjunction with the Western Union office until the latter part of 1883 when he accepted the appointment of manager of the same com-

pany's telephone exchange at Atlanta, Ga., and later was appointed assistant superintendent, which position he held until 1896, when he was again promoted to the position of general superintendent of construction for the entire territory of the company, which included seven southern states. In 1901 Mr. Gentry became general manager, and in 1903 was elected vice-president and general manager, which position he now holds with headquarters at Atlanta.

GEORGE W. DAVENPORT.

MR. GEORGE W. DAVENPORT, whose portrait is presented herewith, has, as noted in these columns, been elected recently third vice-president of the Niagara Falls Power Company, that office having been created quite recently. The appointment took effect on Jan. 1 and Mr. Davenport is now in residence at Niagara Falls, where he will perform the duties assigned to him by the second vice-president, whom he will assist, Mr. Rankine, finding that the constantly increasing business of the Niagara Falls Power Company and its allied concerns demands attention from a man of Mr. Davenport's scope of experience, energy and ability. Mr. Davenport, after a course in the Massachusetts Institute of Technology, and factory experience with the Thomson-Houston Electric Company at Lynn, Mass., became general manager of the Thomson-Houston International Company, and for eight years was connected with that company and the General Electric Company. When the General Electric Company, in 1893, turned over to a board of trustees, known as the trustees of Street Railway and Illuminating Properties, over ten millions of securities of various electric lighting and railway companies situated in different parts of the United States, Mr. Davenport became assistant to the trustees, and had a varied experience in the examination, operation, and management of many of the 136 properties in which the trustees were interested. He has recently been second vice-president of the Planters' Compress Company, whose head office is in Boston. As an associate of Mr. C. A. Coffin in the old Thomson-Houston days, and latterly as an expert and manager in connection with electric light and power properties, Mr. Davenport has made a great success, being also one of the most widely known men in the central station field. He is a man of marked personality, charming manners and is not only conversant with affairs but a deeply read student, one of his hobbies being the collection of old books and early electrical literature. His new appointment gives much pleasure to a host of friends who have watched his career with interest.

DR. LEE DE FOREST has returned from England where his wireless telegraph system has been attracting considerable attention.

MADAME CURIE, of radium fame, has been awarded $12,000 as part of the Osiris prize by the Institute of France, and M. Branly has been awarded the remaining $8000.

MR. W. T. JACKSON, western representative, was recently in Chicago on an extended trip throughout the west, in the interests of G. M. Gest, the contractor of Cincinnati, New York and Boston.

MR. ERNEST H. DAVIS, secretary of the National Electric Light Association, has advised members that the transactions for last year will soon be out, but has been delayed by the unusual bulk of its contents.

MR. GUY E. PAINE, formerly superintendent of the Postal Telegraph-Cable Company, at St. Louis, has been appointed general superintendent of the southern division of the same system, with headquarters at Atlanta, Ga.

MR. H. F. PARSHALL, the well-known consulting electrical engineer who has so long been domiciled in England and engaged there on important electric railway work is visiting this country for a brief stay of two or three weeks.

MR. F. M. ASHLEY has become associated with Philip K. Stern and will conduct business under the firm name of Ashley & Stern at 130 Fulton Street, New York, as consulting electrical and mechanical engineers and solicitors of patents.

MR. GUSTAVO LOBO, an electrical and mechanical engineer, well known at one time in this city, announces his wedding at the Church of Our Lady of Lourdes, City of Mexico, to Miss Maria de los Dolores, daughter of Mr. and Mrs. Agustin Pradillo, of that city.

MR. AUGUSTUS D. WALLER, a well-known English educator and member of the Senate of London University, is about to publish in this country through E. P. Dutton & Company a small volume entitled "Eight Lectures on the Signs of Life from Their Electrical Aspect."

MR. B. F. ALLEN, chief engineer of the Harrisburg, Pa., Foundry Company Machine Works, was in town for a few days this week. He reports that business is very promising and that the works have contracts in hand which will keep them busy night and day for at least four months.

MR. G. H. PIERCE.—The International Telephone Mfg. Company, of Chicago, has secured the services of Mr. Geo. H. Pierce, who formerly represented the Stromberg-Carlson Company in New York and New Jersey. Mr. Pierce will cover the state of Iowa with headquarters at Des Moines.

MESSRS. RUEBEL & SCHULTE, engineers of the Anheuser-Busch Brewing Company, of St. Louis, Mo., are now in New York for the purpose of securing estimates for equipment to be installed in an extension to the company's plant. It is proposed to install 800-hp of additional electrical machinery.

MR. ANATOL FOMILIANT, student at the Imperial Technical College of Moscow, Russia, is on a visit to this country to make arrangements for an excursion to the World's Fair of a body of students from the Moscow College. The excursion has been authorized by, and will be under the auspices of, the college authorities.

MR. MAX LOWENTHAL, secretary and engineer of the Prometheus Electric Company, of New York, has started on a trip through the eastern and middle states to establish agencies for the electric heating apparatus of that concern. A number of interesting technical problems await his attention. The company has already established several agencies.

MR. A. FREDERICK COLLINS has recently prepared three contributions for the Encyclopedia Americana of the *Scientific American* on telegraphy, wireless telegraphy and wireless telephony. He has also been a contributor to the International Encyclopedia on wireless telegraphy. Some of his recent "popular" work for the *New York Herald* has been excellent.

MR. FRANK WISNER has been appointed chief electrician of the electrical equipment in the various power houses of the Cleveland Electric Railway Company. He succeeds Mr. George Bacon who has become identified with the Willard Storage Battery Company of Cleveland. Mr. Wisner was formerly chief electrician of the Cleveland City Railway Company.

MR. ANDREW KEISER, superintendent of telegraphs of the Pennsylvania Railroad, and Mr. R. H. Rudd, assistant engineer of signals, are going abroad to study features of transportation work in Europe, including England, France and Germany. Mr. R. E. McCarty, assistant superintendent of the Pittsburg division of the Pan Handle system, is to accompany them.

MR. W. E. L. GAINES, general manager of the National Telephone Company, London, and Mr. Frank Gill, engineer-in-chief of the same company, are making a tour of telephone and electrical plants of this country and Canada. They recently visited the exchange of the Buffalo Telephone Company and then went to Niagara Falls to inspect the power plants there.

MR. J. E. WOODBRIDGE, of the railway engineering department of the General Electric Company at Schenectady has been transferred to the British Thomson-Houston Company, at Rugby, England, where he should now be addressed. Mr. Woodbridge was at one time editor of *The Electrical World* and left its staff a few years ago to devote himself more particularly to direct engineering work.

MR. E. G. LONG, who was for several years associated with the Brush and General Electric companies, and who, during the past five years, has acted as vice-president and general sales agent of the Peckham Mfg. Company, has opened offices at 95 Liberty Street, for the purpose of doing business in electric railway materials. Mr. Long will make a specialty of catering to the export trade and is figuring on some substantial contracts.

MR. SAMUEL INSULL, president Chicago Edison Company, has been in New York City this week, taking among other things an active share in the Edison Medal Association of which he is chairman and which intends to present its fund to the Institute at the annual dinner at the Waldorf on February 11. Mr. Insull is also very much interested in the historical exhibit of the Edison companies to be made at St. Louis this year.

MR. W. J. JOHNSTON has sold to Mr. H. M. Swetland his stock interest in the Johnston Publishing Company, the corporation which owns *The Engineering and Mining Journal*, and has severed his connection with that publication. Mr. Johnston will now devote his entire time and energies to the development of the *Pacific Coast Miner*, which he has owned personally for the past year, but to which heretofore he has only been able to give "absent treatment."

MR. H. M. DEAVITT, analytical and consulting chemist and assayer, with a large practice in Chicago, has taken the management of the Chicago office of the Engineering Company of America, 159 LaSalle St. Mr. Ellis C. Spoker, the expert in cement plants, has also become associated with the Engineering Company of America with headquarters at its Chicago office. Mr. Edward Everett, civil engineer, who has specialized in railroad work, and who made the survey for one of the Hudson River tunnels, has become associated with the company at its New York office, 74 Broadway.

MR. M. G. HUBBARD who has been recently elected secretary and treasurer of C. E. Hewitt & Company, engineers and contractors, Park Row Building, New York, was for 13 years engineer and general superintendent of the McGuire Manufacturing Company, of Chicago. For the last three years he has been engaged in exporting railway supplies at No. 114 Liberty St., New York. While with the McGuire Manufacturing Company he spent considerable time on the road and became well known in electrical railway circles. By experience and training he is well fitted for his new business, and his many friends will wish him every success.

MR. N. S. BRADEN, formerly manager of the Westinghouse Electric & Manufacturing Company's district office at Cleveland, Ohio, has been appointed sales manager of the new Canadian Westinghouse Company, Ltd., and assumed the duties of that office on Jan. 1, 1904. Mr. Braden succeeds the late Mr. Thomas C. Frenyear, who died on Dec. 10. Mr. Frenyear's office was at Toronto, but Mr. Braden will make his headquarters at Hamilton, Ont. Mr. Braden was born at Indianapolis, Ind., thirty-four years ago. He finished his schooling in 1892, and went with the Jenney Electric Motor Company in his native city. He remained with that company until 1899, when he joined the Cleveland district sales office of the Westinghouse Company, as a salesman, where he later became manager.

PROF. S. P. LANGLEY, head of the Smithsonian Institution, was guest of honor at a dinner given by Mr. John Brisben Walker at the Waldorf-Astoria, New York, on January 19. There were many well-known men present. Mr. Walker said that he believed the Langley flying machine would be a commercial possibility within twelve months, and that within twenty-five years it would be the safest means of travel. Santos-Dumont received a rousing welcome. He simply addressed two words to Prof. Langley, these being "Be constant." Edwin Markham, the poet, indulged in a bit of imaginative picturing of the aerial highways of the future. Charles Francis Adams spoke in a similar vein, and went into detail regarding a plan of campaign against neighboring planets. Arthur Brisbane, Gen. Davis, Murat Halstead and others also spoke.

Trade Notes.

THE TRENTON PORCELAIN COMPANY, Trenton, N. J., is manufacturing a high grade of porcelain for all electrical purposes. Its goods have given satisfaction wherever used and the company is increasing its business rapidly. It makes a specialty of all porcelain made for particular uses.

THE HORTON-MASSNICK COMPANY, 11-23 Raynor St., Detroit, Mich., is now putting on the market the "Arkless" fuse formerly manufactured by another concern. This fuse may be placed in any position between terminals any distance apart. This affords a variety of adaptability not usually found.

THE ELECTRICAL POWER STORAGE COMPANY, Limited, 4 Great Winchester Street, London, E. C., England, is distributing its usual annual combination pad, consisting of a desk blotting pad, with a monthly calendar running across the top, and a diary attached to the side. It is a very useful adjunct to any desk. Inside of the diary is an insurance policy covering railroad accidents in the United Kingdom.

THE CENTRAL ELECTRIC COMPANY, Chicago, reports an exceedingly good business on Columbia incandescent lamps for which it is sales agent. Up to this time the Columbia lamp has been manufactured in only the ordinary incandescent and series burning types. The Central Electric Co. is authority for the statement that it will now be able to supply miniature lamps of the Columbia brand which will doubtless meet with a large demand.

THE STUART-HOWLAND COMPANY, of Boston, Mass., is proud of its growth. Starting in a modest way four years ago, it has developed one of the largest supply businesses in New England. In order to impress upon the users of electrical supplies the present size and importance of the concern it has issued a tasteful calendar, with a half-tone illustration on it of its present quarters. The stock which this enterprising company carries of all kinds of supplies makes it a most convenient house to do business with in its section of the country.

THE LUNKENHEIMER COMPANY, Cincinnati, maker of superior brass and iron steam specialties, reports that owing to the unprecedented and growing demand for its specialties, it has again greatly increased its facilities and is now in position to guarantee reasonably prompt shipments. It also reports through its foreign branches an increasing export demand for its specialties and informs us that it will shortly place some new specialties upon the market, which will be contained in a very complete catalogue to be issued in the course of a few months.

FLASH LIGHTS.—Electric portable flash lights are growing more and more popular. The American Endoscopic Company, Providence, R. I., makes a flash and search light that is stated to be up-to-date and complete in every particular. An advantage in the construction of this device is that it can be easily taken apart and examined. On a card recently sent out by the company one of these lamps is shown dissected. The size of the lamp is 1½ by 9 inches and the life of the battery is stated in terms of flashes, being good for 8000 to 10,000 flashes, an equivalent of 7 to 8 hours continuous use. The battery is said to be good for three months' service.

HART & COMPANY, 256 Dearborn St., Chicago, have issued a four-page circular describing their bronze woven-wire gauze brushes, manufactured of the finest bronze woven wire gauze. It is claimed that they need no trimming and very little adjusting and that they will not cut or scratch the commutator. Another production of the concern is their Red Cross commutator compound which lubricates the commutator and prevents cutting. A six-page circular issued by the same people describes their carbon brushes, contains illustrations of six different shapes and styles and gives price on nearly 250 different sizes of brush.

THE TRUMBULL ELECTRIC MFG. COMPANY, Plainville, Conn., has issued a 48-page catalogue bound in an attractive cover which contains illustrations and descriptions of the various knife switches which it makes. In addition to that there are shown illustrations of its rheostats, sockets, cut-outs and the various specialties which it has put on the work recently, including its new flush receptacle taking the Edison base attachment plug. The pendant push button switch on which a patent was allowed in the early part of 1903 is also contained in this catalogue and a sectional view shows the operation very clearly. One push button is used both for opening and closing the circuit.

TAKING CARE OF ORDERS.—At the annual banquet of the Electric Appliance Company, Chicago, on Jan. 9, a series of papers were read by the salesmen and heads of departments dealing with the origin, care and shipment of an order. The taking and shipping of an order would seem to be but a simple matter. Those who listened to this series of papers, however, were impressed with the care and knowledge and thought necessary to properly handle an order to the satisfaction of an up-to-date supply house and of the wide awake customers of to-day. The Electric Appliance Company is to be congratulated upon its admirable organization and on the bright set of men with which it has surrounded itself.

THE CENTRAL STATION ENGINEERING COMPANY has been organized for the purpose of remodeling and placing on a paying basis electric light, street railway, gas and heating properties, which may wish to avail themselves of the experience of engineers who have had broad experience in those lines. They are prepared to investigate properties as to whether improvement is possible, what improvements should be made, and how and where to buy the necessary machinery for such improvements. They are also prepared to furnish plans for complete systems of office book-keeping, both cash and material accounts, so that the conditions of a plant can be ascertained with ease at any time. Mr. R. M. Kimball, vice-president of the Kenosha Gas & Electric Company, is the president in charge of the company. The offices are located at 1430 Old Colony Building, Chicago.

"NIAGRITE."—A material for preventing loss by fire and danger to life from the short-circuiting of high voltage electrical wires, for which the trade mark "Niagrite" has been adopted, is being placed on the market by the H. W. Johns-Manville Company. "Niagrite" is furnished in strips of several widths from 3 inches to 36 inches, suitable for wrapping spirally on electrical cables, and is held in place with asbestos fireproof glue, thus protecting the cables from external fire and confining any internal fire. The material presents a very neat and permanent finish and is not affected by atmospheric conditions. It has been adopted by the Niagara Falls Power Company, International Power Company, Buffalo Street Railroad Company, New York Edison Company, and other important electrical plants. Full particulars may be obtained from the asbestos department of the H. W. Johns-Manville Company, 100 William St., New York.

WATERBURY & COMPANY, of 69 South Street, New York City, Mr. George W. Nock, manager and electrical engineer, have issued the following notice to the trade: "On Jan. 1, 1904, we shall be completely equipped and prepared to fill orders promptly for all classes and kinds of electrical materials, special or standard. We shall be pleased to quote you on armature coils, field coils, or other windings, and to wind armatures complete for generators, motors, converters, etc.; also the designing and building of switchboards and special instruments, together with all special apparatus and materials required in electrical lines, and the laying out of complete installations for light and power purposes. Our plant is entirely new, and is planned with the idea of facilitating all orders, so as to give prompt and efficient service to all our customers at minimum prices. We guarantee all our goods to be the very best that knowledge and skill can produce."

OLD NEW YORK.—The Robins Conveying Belt Company, which has offices in the Park Row Building in this city, has just issued a very handsome broadsheet which is worth framing. It is two feet long by one foot wide, and shows New York as it was 250 years ago and as it is to-day, the contrast between the original old Dutch buildings and the sky scrapers of the present century being very remarkable. The oldest city was certainlly as picturesque as the new, but in most other respects the new seems to have the advantage. Flanking the central pictures of old and new New York are two of buildings typical of the modern city. One shows the Flatiron Building and the other the Park Row Building, which is the highest in the world. We are sorry that the Robins Company cannot associate with this a picture of New York 250 years hence. The contrast between the city of that day and that of to-day would doubtless be as great as that between the two pictures now before us, and in the interim the Robins conveying belt has a lot of work cut out for it.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JANUARY 12, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

748,911. MACHINE FOR COVERING FLAT WIRE; James C. Anderson, Jersey City, N. J. App. filed April 30, 1903. The machine folds the edges of paper tape and then opens the folds and inserts ribbon wire therein.

749,160. ELECTRICALLY OPERATED RAILWAY SWITCH; Claude W. Breedlove and Rudolph R. Grant, Berkley, Va. App. filed Jan. 12, 1904. Details.

749,175. AUTOMATIC AND MANUAL FIRE ALARM; William Livingston Denio, Rochester, N. Y. App. filed May 14, 1903. Details.

749,178. WIRELESS SIGNALING APPARATUS; Lee De Forest, New York, N. Y. App. filed March 5, 1903. A Morse key having a curved arm projecting into a body of oil where the contacts are located.

749,185. ELECTRODE; Rudolf Hager, Halensee, Germany. App. filed Jan. 31, 1901. (See page 176.)

749,191. ELECTRIC SIGNALING APPARATUS; Felix B. Herzog, New York, N. Y. App. filed May 17, 1886. The principal feature consists in employing apparatus at a central station and the sub-stations whereby when the central operator manipulates the receiving apparatus, this will automatically indicate which of the sub-stations has signalled and will give in addition to this indication the signal which the transmitter has been prepared to transmit.

749,193. ELEVATOR; Nelson Hiss, New York, N. Y. App. filed Nov. 11, 1903. An endless cable arranged in two bights and moving always in the same direction, is caused to move the car one way or the other, or not at all, by varying the relative degrees of effort which the motor is permitted to exert upon the two bights of the cable, without changing the speed of the motor.

749,200. HIGH POTENTIAL SWITCH; John F. Kelly, Pittsfield, Mass. App. filed May 23, 1903. A circuit breaker, a device affording an easy path for abnormal frequency currents and a difficult path for normal frequency currents in series with a circuit breaker and means for cutting said device in and out of circuit.

749,204. ELECTRIC HEATING APPARATUS; Richard Kuch, Hanau, Germany. App. filed Nov. 7, 1902. The body to be heated has a strip of platinum foil applied to its surface for carrying the current, this material being of such a nature as to permit of close contact with the body.

749,213. ELECTROMAGNETIC DEVICE FOR VIBRATORY MASSAGE; Eugen K. Muller, Zurich, Switzerland. App. filed Sept. 20, 1902. An alternating current magnet actuating an oscillating knob through which the current passes when it is in operation.

749,224. COMPOUND APPLICABLE FOR INSULATING MATERIAL OR OTHER PURPOSES; Leonard M. Randolph, Newark, N. J. App. filed April 25, 1902. Varnish residue deprived of its liquid constituents.

749,225. TELEPHONE SYSTEM; Hope Redmon, Rufus L. Hall and Robert H. Conway, Cynthiana, Ky. App. filed Nov. 10, 1902. (See page 179.)

749,252. SYNCHRONIZER; Leonard Andrews, Manchester, England. App. filed June 25, 1903. For coupling alternating generators to the same circuit, a lamp indicator is operated without moving parts but through transformers having two primary windings and two secondary windings so connected to the generators, bus-bars and the indicator that one of the

secondaries is excited when the current of both primaries are in phase and the other when the currents are in opposition.

749,255. ELECTRIC INTERLOCKING SWITCH AND SIGNAL SYSTEM; Gustave Bleynie and Theophile Ducousso, Paris, France. App. filed March 6, 1902. Details.

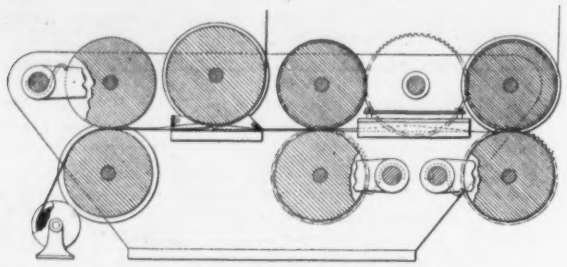
749,261. SWITCH; Troy Cope, New Waterford, Ohio. App. filed Aug. 20, 1903. Details.

749,268. ELECTRIC ARC LAMP; George R. Davison, Pittsfield, Mass. App. filed May 8, 1903. Such air as enters the globe through the carbon passage, must pass through a thin passage, the walls of which are heated, before it mingles with the gases in the globe.

749,271. ELECTRIC MOTOR CONTROL; Samuel T. Dodd, Pittsfield, Mass. App. filed June 4, 1903. A plurality of motors are controlled by shifting them from series to parallel while maintaining the connection of each armature to the corresponding field and using that armature and half of its field as an element in all combinations.

749,272. MOTOR CONTROL; Samule T. Dodd, Pittsfield, Mass. App. filed June 13, 1903. See preceding patent.

749,301. TROLLEY STAND; Washington H. Kilbourn, Greenfield, Mass. App. filed Aug. 14, 1902. Embodying among other details means for preventing the trolley pole from flying upward when the wheel leaves the wire.



748,911.—Machine for Covering Flat Wire.

749,306. TELEPHONE SYSTEM; Albion T. Libby, Chicago, Ill. App. filed Dec. 3, 1902. (See page 179.)

749,308. TELEPHONE-EXCHANGE; Frank A. Lundquist and John K. Norstrom, Chicago, Ill. App. filed Nov. 19, 1900. (See page 179.)

749,335. INSULATOR; Louis Steinberger, Brooklyn, N. Y. App. filed Sept. 18, 1902. A metallic sleeve is inserted in a porcelain insulator for strength, the sleeve then being filled with an insulating material and having a seat in its rear portion for the conductor.

749,336. INSULATED SUPPORT FOR WIRES; Louis Steinberger, New York, N. Y. App. filed Nov. 12, 1902. A clip for trolley wires in which a block of insulating material is inserted between the wire clamp and the supporting nipple.

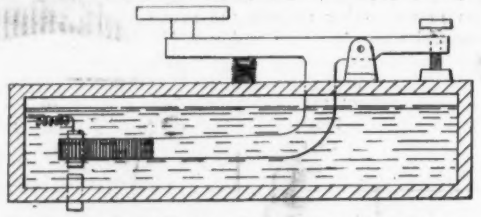
749,365. ELECTRIC BELL; Harry E. Dey, New York, N. Y. App. filed Aug. 15, 1901. A magnet having a reciprocating core projecting at both ends, is placed obliquely inside of two gongs, so that the core will strike one gong when moving in one direction and the other when moving in the opposite direction.

749,370. WIRELESS SIGNALING SYSTEM; Cornelius D. Ehret, Ardmore, Pa. App. filed Nov. 15, 1902. Consists in increasing the current of the received energy after having been transformed into the energy of currents in the receiving circuit.

749,371. WIRELESS TELEGRAPH RECEIVER; Lee De Forest, New York, N. Y. App. filed June 4, 1903. A magnetic detector for use with a duplex system whereby waves of other character than those for which the apparatus is designed, will not injuriously affect the receiving apparatus.

749,372. ART OF WIRELESS TELEGRAPHY; Lee De Forest, New York, N. Y. App. filed June 4, 1903. The method of sending a warning signal consisting in emitting a recurring series of high frequency waves varying both in their spark frequencies and in their continuity in accordance with a predetermned cycle, and in translating the waves into audible sound.

749,387. AUTOMATIC NON-INTERFERING REPEATER FOR FIRE



749,178.—Wireless Signaling Apparatus.

ALARM CIRCUITS; Wm. H. Kirnan, Bayonne, N. J. App. filed Oct. 4, 1902. Non-interference magnets corresponding with the street-box magnets, prevent the operation of the repeater by any one of the street magnets while under the control of any other of them.

749,391. BOND FOR CONDUITS FOR ELECTRIC WIRES; George A. Lutz, New York, N. Y. App. filed May 7, 1901. A corrugated metal strap embracing the joint of conduit sections.

749,392. ELBOW FOR CONDUITS FOR ELECTRIC WIRES; George A. Lutz, New York, N. Y. App. filed May 7, 1901. The cover of the elbow is confined by lugs located at intervals around the curve and bent over the edge of the cover.

749,399. ALTERNATING CURRENT RELAY; Greenleaf W. Pickard, Amesbury, Mass. App. filed Aug. 21, 1903. A novel electro-magnetic movement actuated by alternating currents and employing three pole pieces, one of which is movable between the other two, and a coil embracing the movable pole and one of the other two pole pieces, the object being to provide a call receiving apparatus promptly responsive to alternating currents of high frequency and equally responsive reversely to the cessations of such current.

749,401. ELECTRIC RAILWAY; Leon W. Pullen, Philadelphia, Pa. App. filed April 18, 1903. Details of a system wherein magnets carried by the car actuate circuit controllers in the road bed to energize contact studs fixed at suitable intervals along the way.

749,409. IGNITING DEVICE FOR ACETYLENE GAS BURNERS; Henry C. Thomson, Boston, Mass. App. filed Nov. 6, 1902. Details.

749,416. SAFETY APPLIANCE SYSTEM FOR ELECTRICALLY ACTUATED ELEVATORS; Harry G. Wright, Providence, R. I. App. filed May 9, 1903. Relates to that class of machine adapted to automatically prevent the car from moving in case any of the landing doors are not fully closed.

749,418. METHOD OF MAKING CARBON ARTICLES; Edward Goodrich Acheson, Niagara Falls, N. Y. App. filed Sept. 4, 1902. (See page 176.)

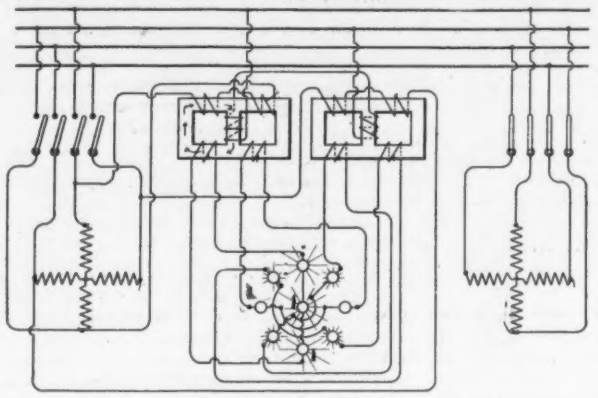
749,426. LIGHTNING ARRESTER; William E. Cone, Memphis, Mo. App. filed May 28, 1903. Details.

749,434. WIRELESS SIGNALING APPARATUS; Lee De Forest, New York, N. Y. App. filed June 4, 1903. The spark determining member of the transmitting apparatus cuts the indicating member of the repeating apparatus out of the circuit during the time of each spark in the transmitting apparatus.

749,435. GENERATING SET FOR WIRELESS TELEGRAPHY; Lee De Forest, New York, N. Y. App. filed June 17, 1903. The set comprises an explosive engine, a dynamo, a choke-transformer, step-up transformer, a sparking circuit and a radiating conductor.

749,436. WIRELESS TELEGRAPH RANGE FINDER; Lee De Forest, New York, N. Y. App. filed June 17, 1903. A distance indicator comprising a variable resistance adapted to be inserted in the circuit with the indicating device in quantities having values proportioned to different distances.

749,439. ELECTRICAL CONTROLLING APPARATUS; John D. Ihlder,



749,252.—Synchronizer.

Yonkers, N. Y. App. filed March 22, 1902. The speed of an alternating current motor can be automatically changed while it is in operation.

749,442. OUTLET BOX; Hubert Krantz, Brooklyn, N. Y. App. filed May 25, 1903. The openings are covered by removable disks which are held in place by radially projecting ears.

749,448. TELEPHONE-TRANSMITTER; Philip G. Randall, Boston, Mass. App. filed Feb. 9, 1903. (See page 179.)

749,460. ELECTRIC FURNACE; LeRoy W. Stevens and Bernard Timmerman, Chicago, Ill. App. filed Aug. 8, 1902. (See page 176.)

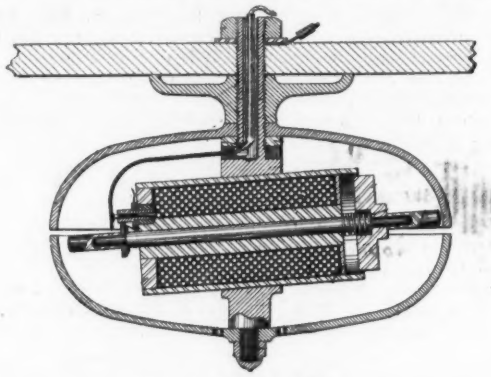
749,461. ELECTRIC FURNACE; LeRoy W. Stevens and Bernard Timmerman, Chicago, Ill. App. filed Oct. 29, 1902. (See page 176.)

749,462. FURNACE; LeRoy W. Stevens and Bernard Timmerman, Chicago, Ill. App. filed Oct. 30, 1902. (See page 176.)

749,481. TELEPHONE REPEATER; Merritt Gally, Brooklyn, N. Y. App. filed April 18, 1903. (See page 179.)

749,495. ELECTRIC STRIKING CLOCK; William Olson, Jersey City, N. J. App. filed Dec. 31, 1902. Details.

749,500. MINER'S ELECTRIC LAMP; Henry G. Prested, Camden Town, England. App. filed Feb. 7, 1903. The combustible gas diffusing through a porous diaphragm at a rate different from that at which air diffuses, is utilized to move a contact controlling the circuit of a glow lamp .



749,365.—Electric Bell.

749,509. TROLLEY; Willis D. Williams, Kirkland, Arizona Ter. App. filed Aug. 19, 1903. The flanges of the wheel are flanked by spiders, the arms of which project to retain the wheel on the wire.

749,584. WIRELESS SIGNALING SYSTEM; Harry Shoemaker, Philadelphia, Pa. App. filed Oct. 3, 1902. A plurality of local circuits controlled by the wave-responsive device, each circuit containing means for selecting a certain message to the exclusion of other messages which may be simultaneously received.

749,597. ELECTRIC RAILWAY SWITCH; Johann G. Weniger, New York, N. Y. App. filed June 9, 1903. Details.

749,601. TROLLEY HARP DEVICE; Frederick H. Allen, Dunkirk, N. Y. App. filed Nov. 2, 1903. A construction enabling the wheel to be quickly removed and replaced.

749,628. ELECTRIC HEATER; George J. Peacock, Pittsburg, Pa. App. filed April 19, 1902. An electric heater embedded in protective material surrounding a water plug.

749,633. ELECTRICAL HOSE SIGNALING APPARATUS; William G. Seeley, Brookline, Mass. App. filed May 25, 1903. Details of the joint for maintaining the continuity of the circuit

749,657. AMUSEMENT AND ADVERTISING DEVICE; Miles W. Beemer, New York, N. Y. App. filed Jan. 5, 1903. A miniature lighthouse with a battery and motor in the base whereby the light shows alternately white or red.

749,694. MEANS FOR DETERMINING THE NAUTICAL BEARING OF NAVIGABLE VESSELS; Hermon W. Ladd, Boston, Mass. App. filed May 15, 1899. A conductor for catching Hertzian waves is shielded on all side except one, the shield being mounted to rotate and to carry with it an index that plays over a compass dial. When a signal is received, the position of the index indicates the bearing whence it came.

749,705. REGULATOR FOR INCANDESCENT LAMPS; Frederick C. Schofield, Washington, D. C. App. filed May 7, 1903. Details of a rheostat placed in the socket of the lamp.

749,710. ELECTRIC BLOCK SIGNAL SYSTEM; Louis C. Werner, Broadbrook, Conn. App. filed Dec. 12, 1901. A four-position semaphore and means for locking it at each position.

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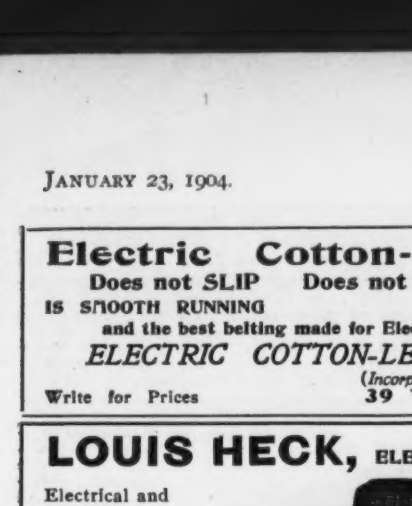

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The rate for "Position Wanted" advertisements of forty words or less is one dollar an insertion; additional words two cents each, payable in advance. Remittance and copy should reach this office not later than Tuesday morning for the next succeeding issue.

POSITION WANTED.—As master mechanic in lighting, power or other plant; complete knowledge of electricity, steam, plumbing, steamfitting, construction work; 25, married; wages $100 per month. Address No. 1200, care Electrical World and Engineer, New York.

POSITION WANTED.—A young technical college man desires drafting or tracing to do evenings and Saturdays; have had experience with large electrical companies; can furnish highest references as to character and ability. Address J. L. D., 176 Willoughby Ave., Brooklyn, N. Y.

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POSITION WANTED.—With electrical contractor; an all around man that can be sent out on any kind of work; can lay out work for men and superintend generally, or would accept position as first-class workman. Address No. 1202, care Electrical World and Engineer, New York.

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POSITION WANTED.—By a graduate of the Light and Power Course of the International Correspondence Schools, Scranton, Pa., in a subordinate position in a power house or electrical works where he can get experience; will work for moderate wages. Address No. 1265, care Electrical World and Engineer, New York.

POSITION WANTED.—By a first-class electrician, with best of references, as inspector of large lighting and power plant or manager of plant in a city of over 30,000; has also been foreman in one of the largest electric manufacturing establishments; has had good experience in up-to-date shop system. Address No. 1262, care Electrical World and Engineer, New York.

POSITION WANTED.—By first-class electrical and mechanical engineer, with extensive central station and business experience in designing, constructing and operating; technical graduate; best of references; a hustler who knows how to get results. Address No. 1267, care Electrical World and Engineer, New York.

POSITION WANTED.—By young, energetic, thoroughly qualified and experienced man as superintendent of electrical or steam and electrical plant, or large manufactory electrically equipped; age 30; best references as to ability, character, habits, etc. Address No. 1270, care Electrical World and Engineer, New York.

HELP WANTED.

The rate for "Help Wanted" advertisements of forty words or less is one dollar and fifty cents on insertion; additional words three cents each, payable in advance. Remittance and copy should reach this office not later than Tuesday morning for the next succeeding issue.

WANTED.—On April 1st an all around man to take charge of a small electric plant; must have experience with engine, dynamo, wiring inside and out; state age, experience, salary expected, references. Address No. 1269, care Electrical World and Engineer, New York.

WANTED.—Three experienced incandescent lamp salesmen, by an old and well established company not in the Trust; applicants will please state age, experience and salary wanted. Address No. 835, care Electrical World and Engineer, New York.

WANTED.—Engineers and salesmen to handle France "Steam Stopper" brands of Metallic and Fibrous packing as a side line. Good inducements to the right party. Address France Packing Company, Tacony, Phila., Pa.

WANTED.—Man able to superintend inside construction work, who will purchase shares of stock in electrical contracting business in Boston. Address No. 1260, care Electrical World and Engineer, New York.

WANTED.—Salesman to travel the middle Western States; must be well educated and thoroughly posted upon rheostats, controllers, etc. Apply No. 1263, care Electrical World and Engineer, New York.

WANTED.—Chief engineer in small electric light station, near New York City; must be an experienced man in central station operation, thoroughly understanding the economical operation of all central station apparatus; permanent position. Salary $1000.00. Address No. 1268, care Electrical World and Engineer, New York.

WANTED.—Electrical engineer to visit trade for electrical apparatus and specialties; must be familiar with switchboard and railway work; must be a good draughtsman. Apply by letter, stating age, experience and reference, to No. 1272, care Electrical World and Engineer, New York.

(*Continued on page 51.*)

ALTERNATING GENERATORS.

60 CYCLES.

1100 or 2200 volts, 7200 Alternations.

Lt.			Speed.
2	300	Gen. Elec., 15-K.W., comp., single phase, with exciter	720
1	500	Wood, 25-K.W., comp., iron clad armt., single phase, with exciter	720
1	600	West., 30-K.W., comp., toothed iron clad armt., single ph., with exciter	825
1	750	Wood, 37½-K.W., comp, iron clad, armt., single phase, with exciter	525
1	900	West., 45-K.W., comp., toothed armt., 2 phase, 1100 v., with exciter	720
1	1200	West., 60-K.W., toothed armt., single ph., comp., with exciter	720
1	1500	Warren-Medberry, 75-K.W., 2 ph., ind. type, with exciter, 2200 v.	600
1	1500	Stan., inductor, 75-K.W., 2 phase, 1100 or 2200 v., with exciter	900
1	1500	West., 75-K.W., comp., distributed winding, 2 ph., 1100 v., with exciter	900
2	1500	West., 75-K.W., 2 ph., 2200 v., d. c. to 14x14 Gates 4-valve aut., engine, complete with exciter	300
1	1500	Wood, 75-K.W., comp., slotted armt., with exciter	600
1	2400	Gen. Elec. 120-K.W., 3 phase, 2200 or 3300 v., with exciter	600

125-133 CYCLES ALTERNATING GENERATORS.

Lt.			Speed.
1	650	Wood, 33-K.W., comp.,	1680
1	750	West., 37½-K.W.	1650
1	750	Wood, 37½-K.W., comp.	400
1	900	Warren-Medberry, 45-K.W., inductor type	1300
1	1000	Wood, 50-K.W., comp.	1400
2	120	West., 60-K.W., toothed armt., comp.	1650
1	1500	Wood, 75-K.W., comp.	1050
1	1500	Stanley, inductor type, 75-K.W., 1100 or 2200 v., 2 phase	
1	1800	West., 90-K.W., comp., toothed armt.	1500
1	2400	Gen. Elec., 120-K.W., type A 120, latest type, comp., toothed armt	1070
2	2400	Gen. Elec., 120-K.W., type A S, comp., slotted armt.	1070

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Lt.			Speed.
2	2400	West., 120-K.W., comp., self-oiler, toothed armt.	1375
1	4000	Stan., inductor type, 200-K.W., 1100 or 2200 v., 2 phase	670
1	8000	West., 400-K.W., slotted armt., 3 bearings, distributed windings	445

110 TO 125 VOLT GENERATORS.

DIRECT CURRENT.

Lt.			Speed.
4	10	West. Elec., M. P.	1350
1	25	Triumph, M. P., comp.	1400
1	35	Crocker-Wheeler	1200
3	40	Gen. Elec., type I B	1900
1	45	Excelsior, M. P.	900
3	45	West., M. P., comp.	1800
1	45	Gen. Elec., type C E	2050
1	50	Crocker-Wheeler	1150
1	50	C. & C., comp., self-oiler	1550
1	50	Northern, M. P.	2100
3	55	Edison, self-oiler, 3-K.W.	1900
2	60	Hobart, M.P., comp., s-o.	1200
1	75	Hobart, M.P., comp.	1300
2	75	West., M. P., comp.	1650
1	80	Riker, M. P., comp., s-o.	1100
1	80	New Eng., multipolar	1450
1	80	Perrett, multipolar	950
2	80	Card, multipolar	1250
1	80	Crocker-Wheeler, comp.	1350
1	100	Card, M. P.	1000
2	100	Hobart, M. P., comp.	1500
2	100	Northern, M.P., comp.	1600
2	100	Com., M. P., comp.	1350
1	150	Eddy, M. P.	1650
1	120	West. Elec., M.P., comp.	750
1	180	Triumph, M.P., comp.	1200
1	210	Triumph, M.P., comp.	1100
1	210	Eddy, M. P.	1100
1	210	Sprague-Lundell, M. P.,	1050

Lt.			Speed.
1	210	Crocker-Wheeler, M. P.	1000
2	210	Edison, s-o., 12-K.W.	1500
1	250	Fuller, M. P., comp.	580
1	300	Perrett, M. P., comp.	750
1	300	Phoenix, M. P.	1100
1	300	Ahlms-Edwards, M. P.	825
2	350	Edison, 20-K.W., comp.	1400
2	350	C. & C., M.P., 20-K.W.	800
1	350	Card, M.P., comp.	800
1	400	Crocker-Wheeler, M. P.	1150
1	400	Triumph, M. P., comp.	950
1	400	Crocker-Wheeler, M. P.	875
1	400	Northern, 22½-K.W.	1000
2	450	Edison, 25-K.W., s-o.	1300
1	450	Gen. Elec., M. P., comp.	1100
1	450	Sprague-Lundell, M. P.	925
1	540	C. & C., M.P., 30-K.W.	700
1	540	Fisher, M.P., comp.	
2	540	Gen. Elec., M.P., comp.	1000
3	600	Card, M.P., comp.	850
2	700	Commercial, M. P., comp.	865
1	750	Card, M. P., comp.	750
2	800	Edison, 45-K.W., comp.	1000
1	900	Wagner, M. P., comp.	950
2	1000	Edison, s-o., 60-K.W.	700
1	1300	Walker, M. P., 75-K.W.	600
1	1300	Card, M. P., comp.	500
1	1800	Edison, 100-K.W., s-o.	650

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1	100	G. E., 6 pole, comp., d.s. to 12x13 Weston aut. engine, 60-K.W., 125 v.	275
1	1350	Waddel-Entz, 80-K.W., d. c. to Ball engine, 15x14, 125 v.	265
1	1350	Ft. Wayne, comp. d. c. to 13x14 Buckeye vert. engine, 80-K.W., 125 v.	275
2	130	Gen. Elec., M. P., 6 pole shunt, d. c. to Ames tandem comp. 11x17x12 aut. engine, 12 v.	270
1	2500	West. Elec., M.P., comp. for d.c., brand new, 150-K.W., 125 v.	240
1	40	Commercial, M.P., d.c. to 11x12 aut. Chandler-Taylar engine, 250 v.	300
1	75	Siemens & Halske, Churchward type, M.P., brand new, for d. c., 250 v.	300
2	75	West., 60 cycle, 2 phase, 2200 v., d. c. to 14x14 Gates 4-valve aut. engine, complete with exciter	300

220 TO 250 VOLT GENERATORS.

K.W.			Speed.
1	12	Crocker-Wheeler, M. P.	1000
1	12	Card, M. P., comp.	800
1	12	Westinghouse, M. P.	1400
1	15	Edison, self-oiler	1400
1	20	Western Electric	150
1	20	Edison, self-oiler, comp.	1400
1	20	Wagner, multipolar	1200
1	20	Keystone, M. P., comp.	950
1	20	Eddy, M. P., comp.	950
1	20	Diehl, M. P., comp.	925
1	25	Crescent, multipolar	1000
1	25	Commercial, s-o, comp.	1380
1	30	Western Elec., M. P.	600
1	30	Triumph, M. P., comp.	950
1	37½	Keystone, M. P., comp.	800
1	40	C. & C., M. P., comp.	750
1	40	Crocker-Wheeler,	950
1	40	Eddy, M. P., comp.	850
1	40	Keystone, M. P., comp.	900
1	45	Am. Engine C., M. P.	750
2	45	Edison, comp., self-oiler	1000
1	45	Gen. Elec., M. P., comp.	925
1	59	Eddy, M. P., comp.	850
1	50	Triumph, M. P., comp.	900
1	55	Fuller multipolar, comp.	750
1	70	Western Electric, comp.	585
1	75	C. & C., M. P., comp.	525
1	80	C. & C., comp., self-oiler	625
1	100	Edison, comp., self-oiler	650
1	100	Commercial, M. P., comp.	750
2	220	Eddy, M. P., comp,	700
1	125	Thompson-Ryan, M. P.	375
1	125	Siemens & Halske, M. P.	
2	150	National, M. P., comp.	350
1	200	Eddy, M. P., comp.	500
1	300	Western Elec., M. P.	480

500 TO 550 VOLT GENERATORS.

K.W.			Speed.
1	60	Edison, comp., self-oiler, new armt. and commutator	700
1	62	T.-H., D 62, s-o., comp.	900

DYNAMOS ❁ MONEY SAVERS ❁ ENGINES

110 VOLT GENERATORS AND MOTORS

2—60-K.W. Edison bipolar.
2—45-K.W. Edison bipolar.
1—30-K.W. Loomis 4 pole.
1—21-K.W. Riker 4 pole.
1—17½-K.W. General Electric, 4 pole.
1—15-K.W. Edison bipolar.
1—12-K.W. Card 4 pole.
1—10-K.W. Detroit bipolar.
1—15-H.P. Riker, 4 pole motor.

220 VOLT GENERATORS AND MOTORS

1—120-K.W. C. & C. 6 pole.
1—60-K.W. Northern Electric, 6 pole.
1—50-K.W. Bullock, 4 pole.
1—16-K.W. Ft. Wayne, 4 pole.
1—60-H.P. Bullock, 4 pole motor.
1—15-H.P. Keystone bipolar motor.
1—10-H.P. Excelsior bipolar motor.
1—7½-H.P. American Ball 4 pole.
1—5-H.P. Sprague, bipolar.
1—3-H.P. Belknap, 4 pole.

500 VOLT GENERATORS AND MOTORS

1—300-K.W. Westinghouse, 6 pole.
1—200-K.W. Edison bipolar.
2—175-K.W. Edison bipolar.
1—150-K.W. Westinghouse, 4 pole.
2—125-K.W. Westinghouse, 4 pole.
1—110-K.W. General Electric, 6 pole.
2—100-K.W. General Electric, 4 pole.
1—100-K.W. Westinghouse, 6 pole.
2—100-K.W. Edison bipolar.
4—75-K.W. General Electric, 4 pole.
1—75-K.W. Westinghouse, 6 pole.
3—47-H.P. Ft. Wayne 6 pole motors.
1—15-H.P. Crocker-Wheeler, 4 pole.
1—12-H.P. Edison bipolar.
1—7½-H.P. American Ball, 4 pole.
1—7½-H.P. T. H., type D.

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300-K.W. (two) West., 2 ph., 60 cy., 2200 v., & Cross compound 4 valve engines.
300-K.W. Westinghouse, 8 pole, 550 v., & Cross compound 4 valve engine.
80-K.W. Jenney, 110 v., & Russell.
50-K.W. Walker, 110 v., & Russell.
50-K.W. (two) Am. Ball 220 volt, & engine.
25-K.W. G. E., 110 v., & Fisher.
7½-K.W., 6-K.W., 4-K.W., & 3-K.W. Northern Elec. dynamos, d.c. engines (new).

ALTERNATING

150-K.W. Warren, 60 cy., s. ph., 2200 volts.
100-K.W. G. E., 3 ph., 60 cy., 2300 volts.
150-K.W. G. E., type A.M., 125 cy., 2300 volts.
100-K.W. G. E., type A.M., 125 cy., 1250 volts.
65-K.W. Stanley, 60 cy., 2 ph.
60-K.W. G. E., type A., 125 cy.
20-H.P. Westinghouse, 2 ph., 60 cy. motor.
7½-H.P. Westinghouse 2 ph., 60 cy.

ENGINES

3—17x28x18 Harrisburg, tandem.
3—11x17x14 Harrisburg, tandem.
1—24x48 St. Louis Corliss.
1—17½x32 Buckeye automatic.
1—20x20 Harrisburg, standard.
2—18½x18 Ide automatic.
3—14½x16 Buckeye, automatic.
2—17x24 Russell 4 valve.
2—15x20 Russell 4 valve.
1—13x21 Buckeye tangye bed.

BOILERS

4—72x18' return tubulars, 125 lbs.
2—72"x16' return tubulars, 125 lbs.
6—66"x16' return tubulars, 100 lbs.

Boilers **THOMPSON SON & CO., 114 LIBERTY ST., N. Y.** Equipments

MODERN ELECTRICAL MACHINERY FOR SALE.

DIRECT CONNECTED UNIT, 220 volts
50-K.W. American Ball Dynamo & Engine.

10 VOLTS DIRECT CURRENT
Dynamos or Motors

30-K.W. Bullock, M. P.
15-K.W. Eddy, M. P.
10-K.W. Eddy, M. P.
5-K.W. C. & C.
3-K.W. C. & C.
2-K.W. Lundell.
1—K.W. C. & C.

500 VOLTS DIRECT CURRENT
Dynamos or Motors

15-H.P. General Elec., M. P.
7½-H.P. General Elec., M. P.
5-H.P. Westinghouse.
5-H.P. Sprague.
2-H.P. General Elec.

220 VOLTS DIRECT CURRENT
Dynamos or Motors

40-H.P. Sprague, M. P.
25-H.P. Crocker-Wheeler, M. P.
20-H.P. Card.
15-H.P. C. & C.
15-H.P. Sprague, M. P.
10-H.P. General Elec.
10-H.P. Holtzer Cabot.
7½-H.P. Card.
7½-H.P. Edison.
7½-H.P. C. & C.
5-H.P. Paragon, M. P.
5-H.P. Holtzer Cabot.
5-H.P. Crocker-Wheeler.
3-H.P. Diehl.
3-H.P. C. & C.
2-H.P. General Elec.
2-H.P. Diehl.
1½-H.P. C. & C.
1-H.P. Crocker-Wheeler.

ALTERNATING INDUCTION MOTORS.

2 Phase, 60 Cycles, 220 Volts

30-H.P. Type F Westinghouse.
15-H.P. Type C Westinghouse.
10-H.P. Type C Westinghouse.
7½-H.P. Type C Westinghouse
5-H.P. Type C Westinghouse.
3-H.P. Type C Westinghouse.
2-H.P. General Elec.
1-H.P. Westinghouse.
½-H.P. General Elec., 220 or 110 v.
¼-H.P General Elec.

2 Phase, 440 Volts, 60 Cycles

30-H.P. Westinghouse.
15-H.P. Westinghouse.
10-H.P. Westinghouse.
7½-H.P. Westinghouse.
5-H.P. Westinghouse.
3-H.P. Westinghouse.
1-H.P. Westinghouse.

3 Phase, 60 Cycles

5-H.P. Westinghouse, 220 volts.
2-H.P. Gen. Elec., 220 volts.
2-H.P. Westinghouse, 220 volts.
½-H.P. General Elec., 220 volts.
½-H.P. General Elec., 110 volts.

Phase, 60 Cycles

7-H.P. Wagner, latest type.
½-H.P. General Elec.
¼-H.P. General Elec.

Phase, 125 Cycles

3-H.P. Wagner, latest type.
2-H.P. Wagner, latest type.
1-H.P. General Elec.
½-H.P. Emerson.
1/10-H.P. Emerson.

Large stock of small motors, auto-starters, starting boxes, rheostats, switchboards, volt-meters, ammeters, etc.

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Send for our Monthly Bargain Sheet showing NET prices—all machines fully guaranteed.

	K.W.		Speed.
1	75	Akron, M. P., 6 pole	900
2	75	Bullock, multipolar	900
2	75	Gen. Elec. M. P., 4, comp.	700
1	100	Edison, comp.	650
1	100	Siemens & Halske, M. P.	600
3	100	Gen. Elec., M. P., 4, comp.	650
1	100	Westinghouse, M. P., 6	650
1	120	Westinghouse, M. P.	625
1	200	Gen. Elec., M. P., 4, comp., s-o., three bearings	400
1	200	Thompson-Ryan, M. P.	525

ARC DYNAMOS.

	Lt.	C.P.		Speed.
1	35	2000	T.-H., L D 2 ball	820
1	45	1200	Brush, No. 7.	1050
1	50	1200	T.-H., L D 12, new ball	820
2	50	2000	T.-H., M D 2, s-o., ring	820
1	65	2000	Brush, No. 8	950
1	75	1200	T.-H., M D 12, s-o,	820
1	75	1200	Wood	950
1	100	2000	Wood	600
1	125	1200	Brush, 6.6 amp.	700
2	125	2000	Brush, 9.6 amp.	500
1	125	1200	Excelsior	700

220 TO 250 VOLT MOTORS.

DIRECT CURRENT.

	H.P.		Speed.
1	1	Crocker-Wheeler, self-oiler	900
1	1	Commercial, self-oiler	1200
1	1	Paragon, self-oiler	1100
1	2	Edison, self-oiler	1600
1	2½	Gibbs, multipolar	1250
1	3	Gibbs, M. P.	1400
1	3	Westinghouse, M. P.	1700
1	3½	Paragon, self-oiler	1000
1	5	Western Electric, M. P.	950
3	5	Gibbs, M. P.	1400
1	7½	Western Electric, M. P.	975
1	7½	Towle, M. P.	1050
1	7½	Commercial, M. P.	1300
1	7½	Gen. Elec., M.P., form H	800
1	10	Sprague-Lundell, M. P.	1175
1	10	Keystone, M. P.	1175
1	10	Lundell, M. P.	1060
1	15	Crocker-Wheeler, M. P.	810
1	15	Card, M. P.	700
1	15	Westinghouse, M. P.	1200
1	18	Edison, 15-K.W.	1150
1	25	Western Electric	525
1	25	Keystone, M. P.	725
1	25	Eddy, M. P.	725
1	25	Diehl, M. P.	750
1	30	Crescent, M. P.	800
1	40	Western Electric, M. P.	400
1	40	Keystone, M. P.	700
1	40	Triumph, M. P.	750
1	45	Crocker-Wheeler, M. P.	850
1	50	C. & C., M. P.	560
1	50	Eddy, M. P.	675
1	50	Keystone, M. P.	750

	H.P.		Speed.
2	60	Edison, self-oiler	75
1	60	General Electric, M. P.	700
1	65	Triumph, M. P.	700
1	65	Eddy, M. P.	650
1	70	Fuller, multipolar	600
1	75	Sprague, self-oiler	500
1	85	Western Electric	500
1	100	C. & C., M.P., 6 pole	450
1	100	C. & C., self-oiler	450
1	125	Edison, self-oiler	550
1	135	Commercial, M. P.	675
2	150	Eddy, M. P.	600
2	200	National, M. P.	300

500 TO 550 VOLT MOTORS.

	H.P.		Speed.
1	1	Crocker-Wheeler	1200
1	1	Diehl, self-oiler	1875
1	1	New England	1100
2	1½	Crocker-Wheeler	1550
2	2	C. & C., self-oilers	1350
1	2	New England, self-oiler	1200
1	2	Crocker-Wheeler	1100
1	2	Lundell	940
2	3	Gen. Elec., type C E	1800
2	3	Crocker-Wheeler	1100
1	3½	Roth, self-oiler, M. P.	950
1	4	Triumph, M. P.	1250
1	4	Perrett, multipolar	725
1	5	Northern, M. P.	1180
1	5	Amer. Engine Co., M. P.	1550
1	5	Westinghouse, M. P.	1500
3	5	Crocker-Wheeler	950
1	7½	Northern, M. P.	1500
1	7½	Crocker-Wheeler	1500
1	7½	General Electric, M. P.	1600
1	10	Perrett, M. P.	600
1	10	Northern, M. P.	1350
1	10	Triumph, M. P.	1100
1	10	Crocker-Wheeler	1275
1	10	General Electric, M. P.	1400

	H.P.		Speed.
1	15	Kester, M. P.	1250
1	15	C. & C., self-oiler	975
1	15	Perrett, M. P.	1100
1	18	T.-H., D 15, self-oiler	1550
1	20	Kester	1400
1	20	S. & H., M. P., Churchward	900
1	20	Perrett, M. P.	700
1	20	Commercial, M. P.	900
1	25	New England, multipolar	900
1	25	Card, multipolar	500
1	35	Card, M. P., self-oiler	775
1	40	Wood, multipolar	750

ALTERNATING CURRENT MOTORS.

SINGLE PHASE. 125-133 CYCLES.

	H.P.		Speed.
1	½	Wagner, 104 v., aut.	2000
1	1	Fort Wayne, 104 volts	2500
1	1	Wagner, 208 volts, aut.	2000
2	1½	Wagner, 208 volts, aut.	2000
1	5	Wagner, 104 volts, aut.	2000
1	⅓	Phillips, 104 volts	1800
1	⅓	Holtzer-Cabot, 104 volts	2500
1	½	Emerson, 104 volts	2000
1	½	Stanley, 104 volts	2000
1	½	Wagner, 104 volts, aut.	2000
1	1	Fort Wayne, 104 volts	2500
1	1	Wagner, 208 volts, aut.	2000
1	1½	Wagner, 208 volts, aut.	2000
1	5	Wagner, 104 volts, aut.	2000

SINGLE PHASE. 60 CYCLES.

	H.P.		Speed.
2	⅓	Phillips, 104 volts	1800
1	⅓	Phillips, 208 volts	1800
3	½	Phillips, 104 volts	1800
3	½	Phillips, 208 volts	1800
1	1	Phillips, 208 volts	1600
1	1	Phillips, 104 volts	1600
3	1	Wagner, 208 volts	1800

	H.P.		Speed.
1	3	Wagner, 208 volts	1800
1	7½	Wagner, 104 volts	1800
1	15	Wagner, 104 volts, aut.	1200
2	30	Wagner, 104 volts, aut.	1200

THREE PHASE. 125-133 CYCLES.

	H.P.		Speed.
1	3	General Electric, 110 volts	1875

TWO PHASE. 60 CYCLE.

	H.P.		Speed.
1	1	West., type C, 110 v.	1800
1	1	West., type C, 200 v.	1700
1	2	Gen. Elec., 220 v.	1800
1	3	Stanley, 500 v., with condenser	1860
1	7½	West., type B, 400 v.	1200
1	20	West., type C, 208 v.	1120
4	50	West., 400 v., type B.	900
1	75	West., 400 v., type B	900
2	100	West., 400 v., type B	720

THREE PHASE. 60 CYCLE.

	H.P.		Speed.
2	1	Gen. Elec., 110 v.	1800
1	2	Gen. Elec., 220 v.	1800
1	3	Gen. Elec., 104 v.	1875
1	5	Gen. Elec., 110 v., type T I	1200
1	10	Gen. Elec., 110 v., form L	900
1	15	Gen. Elec., 110 v., form L	

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Extra Slow Speed Motors, 220 volts, direct-current, suitable for operating drills, lathes, presses and tools of all descriptions electrically—these machines are all in stock and for sale cheap.

	H.P.		Speed.
1	½	Maine, M. P.	450
1	¾	Maine, M. P.	400
4	¾	Maine, M. P.	260
1	1	Maine, M. P.	500
1	1	Maine, M. P.	450
1	1½	Maine, M. P.	500
4	2	Maine, M. P.	260
1	3	Storey, variable speed	300-1500
1	3	Keystone, compound	650
1	3½	Eddy, M. P.	400
1	4	Commercial, M. P.	450
5	5	Western Electric, M. P.	950
1	5	Eddy, M. P.	300
3	5	Belknap, M. P.	230
1	6½	Jenney, M.P., back geared, speed of shaft	440
1	7½	Milwaukee, M. P., series, crane type, grease cup	600
1	8	Crocker-Wheeler, series, crane type	900
1	8	Maine, M. P.	200
1	10	Bernard, M. P.	170
3	10	Bernard, M. P.	130

All machines fully guaranteed.

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450-H.P. 16 and 30x42 Allis Compound Corliss.
450-H.P. 24x48 Brown Corliss.
400-H.P. 23x60 Geo. H. Corliss.
300-H.P. 20x48 Harris Corliss.
250-H.P. 18x48 Lane and Bodley Corliss.
225-H.P. 18x42 Hamilton Corliss.
200-H.P. 18x36 Bates Corliss.
200-H.P. 12 and 22x42 Atlas Compound Corliss.
175-H.P. 16x42 Allis Corliss.
175-H.P. 16x42 Putnam Corliss.
150-H.P. 15x38 Brown Corliss.
125-H.P. 14x36 Allis Corliss.
125-H.P. 14x36 Putnam Corliss.
100-H.P. 12x36 Harris Corliss.
85-H.P. 12x30 Lane and Bodley Corliss.
650-H.P. 28½x52 Buckeye Automatic.
450-H.P. 24x48 Buckeye Automatic.
400-H.P. 16½ and 28½x27 Buckeye Compound Aut.
250-H.P. 16 and 27x16 Westinghouse Compound.
150-H.P. 15x14 Ideal Self Oiling Automatic.
100-H.P. 13x12 Ideal Self Oiling Automatic.
90-H.P. 12x20 Atlas Side Crank Automatic.
90-H.P. 12x16 Erie Center Crank Aut.
40-H.P. 9x13 Frost Side Crank Automatic.

Boilers

1—350-H.P. Babcock and Wilcox Boiler, 150 lbs.
1—280-H.P. Babcock and Wilcox Boiler, 150 lbs.
2—265-H.P. Babcock and Wilcox Boilers, 150 lbs.
3—265-H.P. Babcock and Wilcox Boilers, 135 lbs.
1—175-H.P. Babcock and Wilcox Boiler, 125 lbs.
1—172-H.P. Babcock and Wilcox Boiler, 130 lbs.
1—250-H.P. Cahall Vertical Boiler, 160 lbs.
1—72x18 Tubular Boiler, 130 lbs.
1—72x18 Tubular Boiler, 125 lbs.
7—72x18 Tubular Boilers, 100 lbs.
3—72x16 Tubular Boilers, 100 lbs.
8—66x18 Tubular Boilers, 100 lbs.
3—66x16 Tubular Boilers, 100 lbs.
1—60x18 Tubular Boiler, 100 lbs.
4—60x16 Tubular Boilers, 100 lbs.
2—60x14 Tubular Boilers, 120 lbs.
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30-K.W. Eddy dynamo to Watertown engine, 110 volts.
10-K.W. Westinghouse dynamo to Armington & Sims engine, 110 volts.
10-K.W. Westinghouse dynamo to Westinghouse engine, 110 volts.
80-Amp. Edison dynamo to Brotherhood engine, 80 volts.
20-H.P. Elektron 220 volt motor to Morse Williams freight elevator.

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60-amp. Crocker-Wheeler to Herresoff engine, 110 volts.
2000 volt Electro Dynamic arc dynamo, 10 amperes.
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60-amp. Westinghouse dynamo to Westinghouse engine, 110 volts.
35-amp. Sprague dynamo to Hornby Ackroyd oil engine.
600-Lt. Weston dynamo, 110 volts.
500-Lt. Edison Dynamo, 110 volts, D.C. to Brotherhood engine.
400-Lt. Excelsior dynamo, 110 volts.
45-H.P. C. & C. motor, 230 volts.
30-H.P. C. & C. motor, 230 volts.
15-H.P. Thomson-Houston motor, 500 volts, with spare armature.
15 General Electric, 2-H.P., 220 volt motors.
12 Siemens & Halske 5-H.P., 220 volt motors, 220 volts, 1550 R.P.M.
2 search lights.
These motors are dust proof and series wound.
Large stock of smaller dynamos and motors.
Repairing of electrical machinery in all its branches.

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100-K.W., General Electric, 125-V., M.P. generator, direct connected to 15½ x 16 New York Safety automatic engine.
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100-K.W., 125-V., Edison bi-polars.
150-K.W., 220-V., Edison bi-polars.
75-K.W., 220-V., Western Electric M.P.
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20 x 42 heavy-duty Allis Corliss engine.
24 x 48 Allis Corliss engine.
500-H.P., cross-compound, condensing engine, 150 lbs. steam.

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Electric light plant in town of 1,000 population. In fine shape and on sound financial basis. I did not want to take it, but was obliged to and now want to sell it. New generator and thoroughly overhauled since taking possession. E. E. Secor, Buffalo Center, Iowa.

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Electric light and water system in town of 2,500 population. New brick building. Direct current. Direct-connected 75-kilowatt outfit, also 50,000 gal. tank. Two Cook's 6-in. deep wells and complete system of water mains.

Total cost from $25,000 to $30,000, paying 20 per cent. on cost. Twenty-year franchise with city. Plant in operation only six months.

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2 30-K.W., 1000-volt alternating T. H. single phase dynamos all complete with one extra armature for same, including instruments, exciters, rheostats, belts, etc.; all in running order; will be sold outright to quick buyer. Address No. 1264, care Electrical World and Engineer, New York.

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PROPOSALS will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until 12 o'clock noon, February 9, 1904, and publicly opened immediately thereafter, to furnish at the Naval Torpedo Station, Newport, R. I., a quantity of mine cases, battery boxes, automatic anchors, torpedo cases, single conductor cable, dry battery cells, and rubber washers. Blank proposals will be furnished upon application to the navy pay offices, Newport, R. I., and New York, N. Y. H. T. B. HARRIS, *Paymaster General U. S. N.* 1-9-04

PROPOSALS will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until 12 o'clock noon, February 9, 1904, and publicly opened immediately thereafter, to furnish at the navy yards, League Island, Pa., and Washington, D. C., a quantity of bolts and nuts, rivets, steel wire nails, wood and machine screws, miscellaneous hardware and hand tools, drills, reamers, taps, ash, white pine, cedar, sheet copper, Muntz metal, galvanized sheet steel, structural steel, bar steel, saw blade steel, iron pipe, iron and brass pipe fittings, valves, memorandum pads, press copy books, typewriter paper, blotting and note paper, tracing cloth, miscellaneous stationery, corn brooms, curled hair, emery cloth, upholsterer's leather, sheet gum packing, phosphide of calcium, borax, sal ammoniac, beeswax, electric deck winch, and set of diving apparatus. Blank proposals will be furnished upon application to the Navy Pay Office, Philadelphia, Pa., and to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C. H. T. B. HARRIS, *Paymaster General U. S. N.* 1-15-04

PROPOSALS will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until 12 o'clock noon, February 9, 1904, and publicly opened immediately thereafter, to furnish at the Navy Yards, Portsmouth, N. H., and Boston, Mass., a quantity of wire and cable, conduit and fittings, electrical supplies, bolts, nuts, washers, rivets, miscellaneous hardware and hand tools, drills, hydraulic jacks, files, ratchets, deck winch, traveling cranes, furnaces, ash, white and yellow pine, spruce, brass rod, sheet copper, bar and sheet steel, galvanized sheet steel, solder, sheet lead, bar iron, magnesia blocks and pipe covering, asbestos millboard, hair felting, flax packing, whale oil, engine oil, lard oil, sperm oil, Japan drier, asphaltum varnish, polishing paste, granular sodium carbonate, tallow, gum camphor, brass and copper pipe, lead pipe, iron pipe, valves, brass and iron pipe fittings, lavatories, blank books, pencils, pads, typewriter paper, shipping tags, miscellaneous stationery, toilet paper, laundry and toilet soap, sponges, hair and steel wire brushes, marine cement, oakum, flax twine, plain and khaki cotton twine, lampwick, lacing leather, rigging and bellows leather, buckets, hand and leg irons, squilgees, and emery cloth. Blank proposals will be furnished upon application to the Navy Pay Offices, Portsmouth, N. H., and Boston, Mass. H. T. B. HARRIS, *Paymaster General U. S. N.* 1-14-04

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1—7½-H.P. 220 volt Westinghouse, 900 RPM.
1—15-H.P. Westinghouse, Type C, 930 RPM.
1—20-H.P. 220 volt Westinghouse.
1—30-H.P. 400 volt Westinghouse, Type C., 850 RPM.
1—40-H.P. 400 volt Westinghouse, 900 RPM.
2—50-H.P. Gen. Elec., 220 volt.
1—100-H.P. 220 volt Westinghouse, 600 RPM.

60 CYCLE—THREE-PHASE.

2—1-H.P. 110 volt Gen. Elec., 1800 RPM.
2—2-H.P. 110 volt Gen. Elec., 1800 RPM.
1—2½-H.P. 220 v. Gen. Elec., Type I, 1800 RPM.
2—3-H.P. 220 volt Gen. Elec., 1800 RPM, Type I.
3—5-H.P. 220 volt Gen. Elec., 1200 RPM, Type I.
3—10-H.P. 220 volt Gen. Elec., 1200 RPM.
1—10-H.P. 220 volt Gen. Elec., 1250 RPM.
1—15-H.P. 220 v., Gen. Elec.
1—20-H.P. 220 volt Gen. Elec.
2—30-H.P. 220 volt Gen. Elec., Type I.
1—40-H.P. 220 volt Gen. Elec.
1—50-H.P. 220 volt Gen. Elec.

25 CYCLE—THREE-PHASE

2—5-H.P. 400 volt West., Type C, 750 RPM.
1—5-H.P. 440 volt Gen. Elec., Type I, 750 RPM.
7½-H.P. 440 volt Gen. Elec., Type I, 750 RPM.
1—10-H.P. 200 volt Westinghouse, Type C.
1—20-H.P. 400 volt Westinghouse, Type C, 750 RPM.
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2—50-H.P. 400 volt Westinghouse, Type C, 500 RPM.
5—50-H.P. 200 volt, Westinghouse, Type C.

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1—5-H.P. 220 volt Westinghouse, Type C, 1200 RPM.
1—7½-H.P. 220 volt Westinghouse, Type C, 1200 RPM.
1—10-H.P. 220 volt Westinghouse, 710 RPM, 1200 RPM.
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2—800-K.W. Gen. Elec., Type ATB, 2300 volts, 100 RPM, brand new, direct connected to brand new 1500 to 2100-H.P. McIntosh & Seymour or Pennsylvania Iron Works vertical or horizontal cross compound engines.
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(*Continued from page 48.*)

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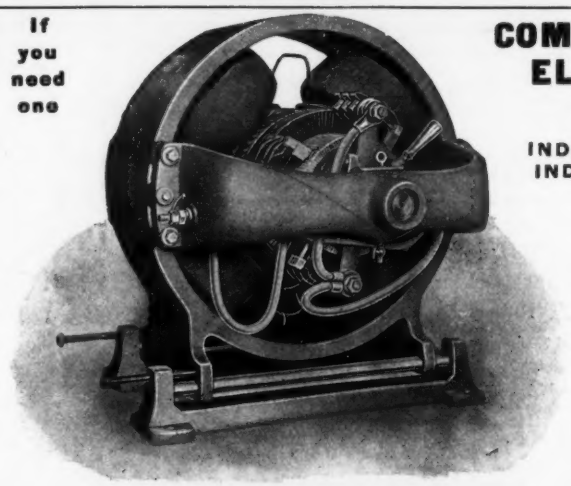

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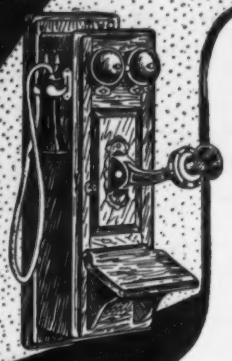

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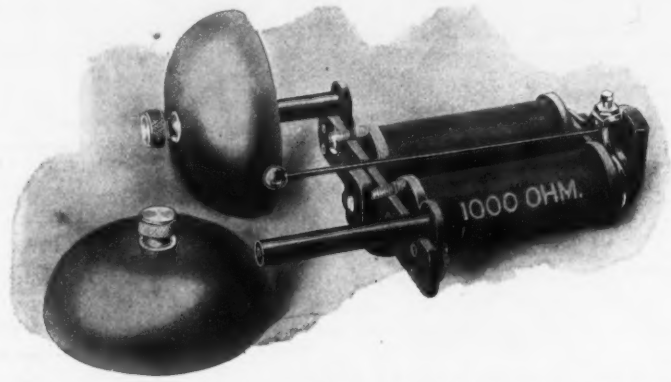

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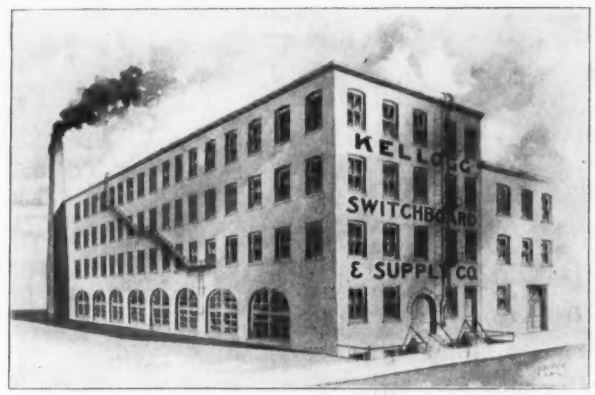

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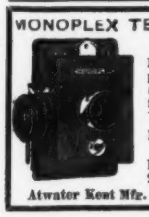

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